

SDMS Document ID



2021281

**PUBLIC
DOCUMENT**

ADMINISTRATIVE
RECORD

RECORD OF DECISION

OGDEN RAIL YARD SITE

Sitewide and OU4 (CVOC ground water plumes)

September 30, 2004

U. S. Environmental Protection Agency
Region 8
999 - 18th Street, Suite 300
Denver, CO 80202

TABLE OF CONTENTS

Part 1: Declaration	1
Part 2: Decision Summary	4
Site Name, Location, and Brief Description	4
Site History and Enforcement Activities	4
Community Participation	9
Scope and Role of Operable Unit or Response Action	11
Site Characteristics	17
Site Conceptual Model	17
Overview (size and topography)	17
Surface and Subsurface features	17
Sampling Strategy	19
Known or suspected sources of contamination	20
Types of contamination and affected media	21
Location of contamination and potential routes of migration	22
Ground water contamination	23
Site Specific factors	24
Current and Potential Future Site and Resource Uses	24
Summary of Site Risks	26
Remedial Action Objectives	49
Description of Alternatives	50
Comparative Analysis of Alternatives	54
Principal Threat Waste	59
Selected Remedy	59
Summary of the Rationale for the Selected Remedy	59
Description of the Selected Remedy	61
Summary of the Estimated Remedy Costs	62
Expected outcomes of the selected remedy	67
Final cleanup levels	68
Statutory Determinations	70
Protection of Human Health and the Environment	70
Compliance with ARARs	70
Cost Effectiveness	71
Utilization of Permanent Solutions	72
Preference for Treatment as a Permanent Element	72
Five Year Review Requirements	72
Documentation of Significant Changes	72
Part 3: Responsiveness Summary	73
Appendix A: Potential Use of Zeolite at Site	

RECORD OF DECISION OGDEN RAIL YARD SITE

PART 1: DECLARATION

Site Name and Location

The Ogden Rail Yard is located on the western side of the City of Ogden in Weber County, Utah. The site is roughly ½ mile wide and 3.5 miles long bounded by Wall Street in Ogden, the Weber River, the 21st Street Pond, and Riverdale Overpass. It is an active rail yard owned by the Union Pacific Railroad.

Statement of Basis and Purpose

This decision document presents the Selected Remedy for the Ogden Rail Yard Site, including OU 4, two plumes of chlorinated solvents, in the Ogden Rail Yard Site in Ogden, Utah, which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, 42 U. S. C. § 9601 *et seq.* as amend, and, to the extent practicable, the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 CFR Part 300. This decision is based on the Administrative Record file for this site.

The State of Utah concurs with the Selected Remedy.

Assessment of Site

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances, or pollutants and contaminants into the environment.

Description of Selected Remedy

The main features of the selected remedy includes removal of the principal threat wastes in and near the former industrial sewer system, monitored natural attenuation of the chlorinated solvents and degradation products, design of a contingency remedy for implementation should the solvent plume move toward receiving waters, and institutional controls to prevent the ground water from being used for domestic, culinary, or other indoor purposes while remediation is ongoing. Due to previous actions taken at the rail yard, no further action is required for addressing soils. The selected remedy at OU 1 (the 21st Street Pond) is addressed in a separate Record of Decision.

Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with or meets the requirements for a waiver of Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

The remedy in this OU does satisfy the statutory preference for treatment as a principal element of the remedy. The primary feature of the selected remedy is monitored natural attenuation, utilizing microbial anaerobic dechlorination of the chlorinated solvents present in the plume.

Because this remedy will result in hazardous substances or pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a policy review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. The site is not on the NPL, but five year reviews will be performed to be consistent with NPL requirements.


ROD Data Certification Checklist

The following information is included in the Decision Summary section of this Record of Decision. Addition information can be found in the Administrative Record for this site.

- Chemicals of concern and their respective concentrations
- Baseline risk represented by the chemicals of concern
- Cleanup levels established for chemicals of concern and the basis for these levels
- How source materials constituting principal threats are addressed
- Current and reasonable anticipated future land use assumptions and current and potential future beneficial uses of ground water used in the baseline risk assessment and ROD
- Potential land and ground water use that will be available at the site as a result of the Selected Remedy
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected
- Key factor(s) that led to selecting the remedy.


Authorizing Signatures

The following authorized officials at EPA Region 8 and the State of Utah approve the Selected Remedy as described in this Record of Decision.



Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation
U. S. Environmental Protection Agency, Region 8

9/30/04
Date



Dianne R. Nielson, Ph.D.
Executive Director
Utah Department of Environmental Quality

10/14/04
Date

PART 2: DECISION SUMMARY

Site Name, Location, and Brief Description

The Ogden Rail Yard site (CERCLIS # UTD000716407) is located in Weber County, Utah, just to the west of the City of Ogden. The lead agency is the U.S. Environmental Protection Agency (EPA), with support from the Utah Department of Environmental Quality (UDEQ). The investigation was conducted by the major responsible party, Union Pacific Railroad, which will also perform the remedial actions required. The site type can be considered as an industrial facility/rail-yard.

The Ogden Rail Yard has been in operation since the first transcontinental railroad reached the area in 1869. Four major railroad companies used the rail yard for switching, maintenance of locomotives and railcars, and for loading, off-loading, icing, and transferring cargo. The rail yard is 3.5 miles in length oriented from North to South and about 1/2 mile wide. This Record of Decision addresses the environmental concerns at OU 4, Ogden Rail Yard Ground Water, and sitewide surface soils.

Site History and Enforcement Activities

The Ogden Rail Yard was built on farmland just to the west of the City of Ogden in 1869 when the first transcontinental railroad was built through the area. Ogden became the transfer point for passengers and goods between the Central Pacific Railroad (later sold to Southern Pacific Railroad) to the west and the Union Pacific Railroad to the east. Soon other railroads were built into Ogden to provide services to destinations to the north and south. The Utah Central Railroad (1870, later bought by Union Pacific Railroad) provided a connection between Ogden and Salt Lake City, and the Utah Northern Railroad (1874, later bought by Union Pacific Railroad and renamed Oregon Short Line Railroad) provided a connection with Idaho and later Montana. The Denver and Rio Grande Western Railroad arrived in 1882 and served southern Utah and Colorado destinations. In 1889, to aid with the passenger and freight transfers between these railroads at Ogden, the mainline railroads formed another railroad company, the Ogden Union Railway and Depot Company. The Southern Pacific and Denver and Rio Grande railroads used the northern part of the yard and the Union Pacific and Ogden Union railroads used the southern part of the yard. Eventually, the Southern Pacific Railroad and the Denver and Rio Grande merged. Later, in 1996, the Union Pacific Railroad bought the Southern Pacific Railroad, so that the Union Pacific Railroad now owns the entire rail yard.

Located at the rail yard were a wide variety of facilities involved with the railroad, including fueling stations and storage tanks, marshaling yards, locomotive repair and maintenance shops, grain elevators, ice plant, passenger depot, freight offices, laundry plant, and 125 miles of switching tracks. It is still in active operation as a rail yard.

Due to the long history of rail yard activities, spills of hazardous substances from the trains were fairly common. Reporting of such spills to governmental authorities was required after 1980. Table 1 gives a list of known spills in the Ogden Rail Yard.

TABLE 1
REPORTED SPILLS
Utah Department of Environmental Quality Data Base

No. and (date)	Spill amount and composition	Location	Status/Cleanup
98 (Feb, 1989)	400 gal diesel fuel	Ogden Rail yard	
1041 (May, 1994)	MTBE ¹ railcar valve cap leaked	Ogden Rail yard	Haz Mat response
1216 (Dec, 1994)	2000 - 5000 gal diesel fuel spilled while filling storage tanks	29 th St Ogden Rail yard	Spill 100 yds in length and 50-60 ft wide.
1230 (Dec, 1994)	200 gal diesel fuel, frozen line	30 th St Ogden Rail yard	cleanup contractor sent
1819 (April, 1996)	75 -150 gal diesel fuel from fuel fitting on locomotive	S Riverdale, 100 yds. south of office	Pacific West vacuumed the waste from asphalt and took off dirt
2172 (Jan, 1997)	5000 - 6000 gal sulfuric acid, hole in railcar	near Riverdale overpass	
2390 (June, 1997)	MBTE, volume unknown	Rail yard 8, track 53	City Haz Mat response
2405 (June, 1997)	diesel and gasoline from leaking USTs ² , found during UST removal	various	County on site
2594 (Nov 1997)	2000 gal diesel fuel from derailed locomotive	G Street and 800 W near the grain elevators	

No. and (date)	Spill amount and composition	Location	Status/Cleanup
2634 (Dec 1997)	25 gal diesel fuel, broken track punctured a switcher engine	33 rd St Ogden Yard cleaning facility Track 510	spill contained in cleaner tank
2921 (Sept 1998)	unknown volume of diesel from rupture in diesel fuel tank of a locomotive	Ogden Yd at Riverdale Inn	
3043 (June, 1999)	2000 gal diesel fuel, rail punctured tank of locomotive	Ogden Rail yard	Clean up contractor
3296 (Dec. 1999)	300 gal diesel fuel, 9 car derailment	31 st St overpass at Rail yard	UP cleanup
3309 (Oct, 1999)	2 railcars derailed from track 22 and slid into a power pole, the power pole and transformer fell onto another railcar on track 23 rupturing transformer, less than 5 gal transformer oil (PCBs ³ not known)	Riverdale East Yard, track 22	Pacific West cleaned up - spill was 6 feet in diameter.
5 (Jan, 2000)	derailment, no spill	Ogden Rail yard	
3317 (Feb, 2000)	MTBE tanker car leaked from bottom, unknown volume	Rail yard	
3447 (May, 2000)	LPG ⁴ railcar leak	Rail yard repair spur	
3788 (Jan 2001)	4 car derailment, no leaks	3311 Pacific Ave	re-railing crew found no leaks
3836 (March, 2001)	locomotive, punctured fuel line, unknown volume	21 st St in Rail yard	contractor on scene

No. and (date)	Spill amount and composition	Location	Status/Cleanup
4024 (July, 2001)	small amount of anhydrous ammonia from open valve	Rail yard	no injuries, valve closed.
4590 (Sept, 2002)	several hundred gal of sulfuric acid from crack in tanker car	Rail yard	cleaned up
4930 (June 2003)	20 gal diesel fuel from top of container	Rail yard	gasket repaired, cleaned up
5030 (Sept, 2003)	no spill, runaway rail car injured worker	3311 Pacific Ave	

¹MTBE, methyl-t-butyl-ether (a gasoline additive to boost octane)

²UST, underground storage tank

³PCB, Polychlorinatedbiphenyl

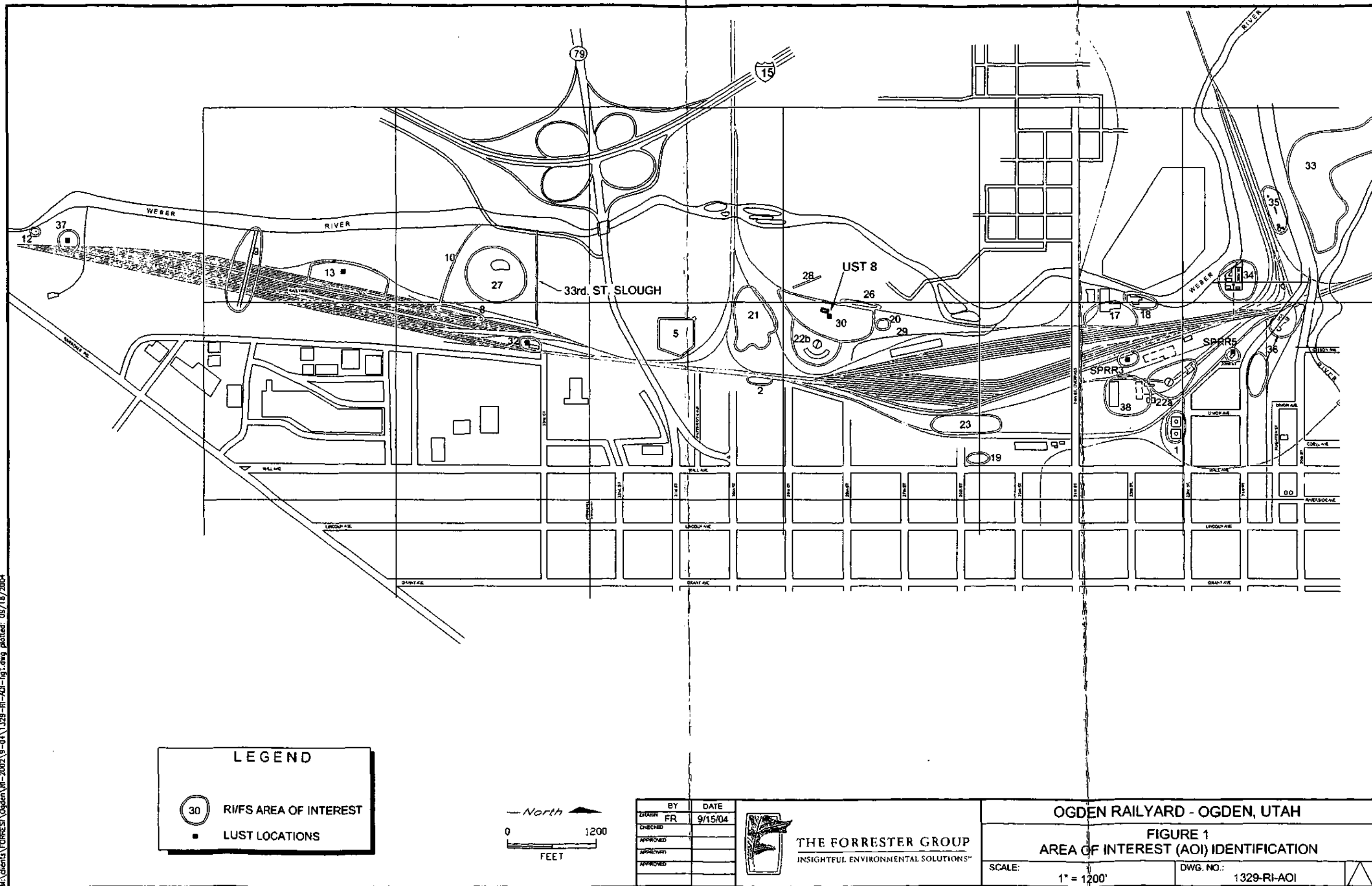
⁴LPG, liquid propane gas

The spills were reported and cleaned up in accordance with the Emergency Response Authorities of CERCLA. The releases at the site leading to CERCLA responses appear to have originated from historical operations. Because the activities which caused the releases of contamination likely occurred before state and federal environmental regulations regarding these substances, no enforcement activities took place prior to CERCLA involvement.

To facilitate assessment, this large site was subdivided into 30 Areas of Interest (AOIs), typically based on aerial photographs (see Figure 1). Initial investigation work began at the site in 1997 (Phase I investigations) to determine if there was a reason for concern at about 34 Areas of Interest which warranted further investigations. The work was done with EPA and UDEQ oversight. Based on these initial results, the RI/FS (Remedial Investigation/Feasibility Study) work proceeded with a focus only on those areas shown to have potential environmental concerns. The Union Pacific Railroad completed the investigation phases with the oversight of the U. S. Environmental Protection Agency and the Utah Department of Environmental Quality under the general framework of an Administrative Order on Consent (AOC) CERCLA 8-99-12. Work on the RI/FS began in 2000; the Remedial Investigation Report (final) was submitted to the agencies in September, 2003; the Feasibility Study Report (draft) was submitted to the agencies in December, 2003. There are no pending lawsuits at this time.

During the course of the remedial investigation, a number of problems were found which were more appropriately addressed by other authorities. The State of Utah

M:\clients\FORREST\Ogden\RI-2002\9-04\1329-RI-AOI-fig1.dwg plotted: 09/16/2004



Underground Storage Tank Program supervised tank removals and any cleanups needed at Areas of Interest 1, 13, 34b, 37, and SPRR3 (See closure reports). EPA's Emergency response authorities were used at Areas of Interest 26 and 27 (Also, see Table 2).

At AOI 26, about 30,000 tons were removed in 1993 and, later, an additional 38 tons were removed from the eastern perimeter of the Fort Buenaventura Park. At AOI 27, approximately 17,445 cubic yards of soils contaminated with oily sludges were excavated and taken off-site for treatment. The excavation covered an area of about 4.3 acres and was about 3 feet deep. Where the excavation did not remove all of the sludge, an HDPE liner, 60 mil thick, was installed. The liner covered about 3.3 acres of the excavated area. After installation of the liner, about 19,969 cubic yards of imported fill was used to cover the liner and fill the excavation. Water that had collected in the excavation during construction was discharged to the Central Weber Sewer Improvement District. A draft closure report was received by EPA on August 24, 2004.

Cleanup of the former Southern Pacific waste water treatment lagoons (AOI 34) was also conducted using Emergency Response authorities. About 172,420 gallons of oily water was removed from the concrete lagoon, treated and discharged by the Central Weber Sewer Improvement District. About 3070 tons of sludges and stabilization materials were also removed off-site for recycling use as road base. Demolition of older unneeded facilities was conducted by the Union Pacific Railroad on a voluntary basis (no enforcement or oversight by government agencies).

OU-4 consists of two contaminated ground water plumes, both characterized by fuels, solvents and degradation products of solvents (see Figure 2). The northern plume originates in the area formerly occupied by the Southern Pacific locomotive maintenance and machine shop facilities. The facilities were serviced by an industrial sewer which may have leaked solvents into the ground along its path. Now the facilities have been demolished and the industrial sewer plugged at the outfall (Weber River). The northern plume underlies a 41 acre area. The southern plume of ground water contaminated with chlorinated solvents originated at the former Union Pacific Roundhouse and overlies a 17 acre area. The plumes are called CVOC plumes (chlorinated volatile organic compounds) for short.

This site has not been proposed or listed on the National Priorities List of Superfund. It is being managed as a "Superfund Alternative Site" (SAS).

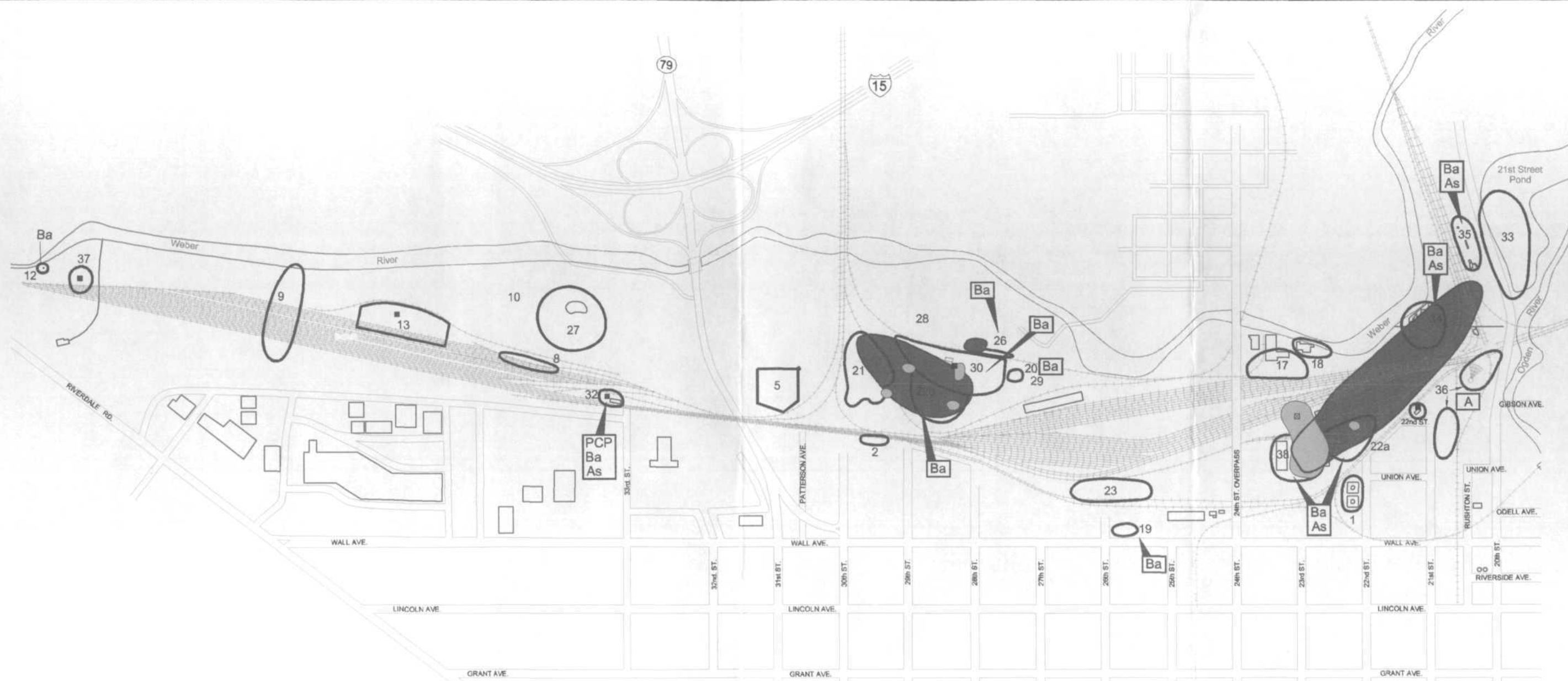
Community Participation

An initial community meeting was held at the site after the initial investigations (Phase I) were completed. The purpose of the meeting was to inform the community what was found during the initial work, to announce the beginning of more in-depth investigations, and to gather ideas from the neighbors about issues which should be

Color Map(s)

The following pages
contain color that does
not appear in the
scanned images.

To view the actual images, please
contact the Superfund Records
Center at (303) 312-6473.



LEGEND

- 30 RI/FS Area of Interest
- LUST Locations

CONTAMINANT PLUMES

- CVOC Plume
- LNAPL Plume

PARAMETER EXCEEDING SCREENING LEVEL

- Ba Barium
- As Arsenic
- PCP CVOC Plume



THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

TITLE:

FIGURE 2
DISTRIBUTION OF GROUNDWATER IMPACTS
UNION PACIFIC RAILROAD FACILITY
OGDEN, UTAH

included in the investigations. EPA and UDEQ went to the neighbors door-to-door to invite them to this meeting. In conjunction with development of the Community Participation Plan, EPA and UDEQ interviewed local residents and local government officials to get their ideas on issues of primary concern.

A committee of local government officials particularly interested in parks, water supply, health, and neighborhoods was formed and met occasionally with the agencies and investigators. City and county officials were kept informed with the latest information as it was discovered. In return, they kept the investigators and agencies informed as to long-term local plans for future use of the site.

The RI/FS Reports and Proposed Plan for this Operable Unit of the Ogden Site were made available to the public on May 26, 2004. They can be found in the Administrative Record file at the Superfund Records Center, at the Utah Department of Environmental Quality Offices and at the local information repository located at the Weber County Offices. The notice of the availability of these two documents was published in the Ogden Standard Examiner on Sunday, May 23, 2004. A public comment period was held from May 26, 2004 to June 28, 2004. In addition, a public meeting was held on May 26, 2004 to present the Proposed Plan to the local citizens. The public was invited to tour the site on the same day. At the public hearing, EPA, UDEQ, and Union Pacific Railroad personnel presented the plans and answered questions about the alternatives and future land use. EPA's response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision.

Scope and Role of Operable Unit or Response Action

This Record of Decision describes the response actions to be taken at the Ogden Rail Yard for all of the Areas of Interest except the 21st Street Pond (Operable Unit 1). The primary focus of the Record of Decision is the Groundwater Operable Unit (Operable Unit 4). Other Areas of Interest were addressed using other authorities (the State's Underground Storage Tank Program, and the EPA Emergency Response CERCLA authority) and will require "No Further Action" under CERCLA. The actions for the groundwater are designed to reduce or eliminate exposures to human health and the environment. Tables 2 and 3 list the various subdivisions of the site, and the authorities used to address the contamination found there.

TABLE 2
AREAS OF INTEREST AT THE OGDEN RAIL YARD
(Areas of Interest in **Bold** indicate primary focus of this ROD)

AOI #	Description	Potential Contamination	Status
1	Above ground diesel storage Tanks	Diesel	Tanks removed in 1998, no leakage observed ¹
2	Grain Storage	pesticides	only grain spillage found, not owned by the railroad, risks below a level of concern ¹
3	Former city landfill west of Weber River	multiple	removed from the site, not owned by the railroad
4a	Junk/Salvage yard, 1600 feet E of yard	metals	removed from the site, not owned by the railroad
4b	Junk/Salvage yard, 3000 feet W of Weber River	metals	removed from the site, not owned by the railroad
5	RR Tie Storage and distribution, operated by NRM (National RR Materials)	wood preservatives	no tie treatment at site, risks are below a level of concern for soils ¹
6	Former Pig Farm	multiple	removed from the site, not owned by the railroad
7	TCE ² Plume, 1600 ft E of yard	VOCs ³ , TCE	removed from the site, not owned by the railroad
8	Former refrigeration car service area	hydrocarbons, refrigerants	now grass covered, risks are below a level of concern for soils ¹
9	Burch Creek and Above Ground Diesel Storage Tanks	multiple, diesel	risks are below a level of concern for soils, some PAH contamination in sediments
10	Storm Drainage Ditch	metals, diesel	risks are below a level of concern for soils, some PAH contamination in sediments

AOI #	Description	Potential Contamination	Status
11	Monitoring Wells east of rail yard	multiple	removed from the site, not owned by the railroad
12	Oil/Water Separator, drip pan area	oils, hydrocarbons	risks are below a level of concern for soils, separator removed in 2000
13	Rail Car Maintenance Area (UST #3 and #4 LUST sites)	oils, hydrocarbons, metals, diesel	ground water contamination, area excavated, LUST program, closed ⁴
14	City of Ogden construction materials landfill	multiple	removed from the site, not owned by the railroad
15	Laboratory 800 ft E of Weber River	multiple	removed from the site, not owned by the railroad
16	deleted by EPA contractor		
17	Surplus storage and Salvage yard, west of rail yard	heavy metals	risks are below a level of concern for soils
18	Dyce Chemical handling and storage facility	spilled chemicals	risks are below a level of concern for soils and gw
19	Former Laundry Building	solvents, chlorinated	risks are below a level of concern for soils and gw
20	Former Diesel Storage Tank	hydrocarbons	Storage tank removed in 1970s, risks are below a level of concern for soils and gw
21	Atlas Steel Salvage Yard	hydrocarbons and metals	subsurface impacted by southern CVOC plume, the subject of this ROD, LNAPL ⁵ , surface soils contaminated with metals
22a	Former SPRR (Southern Pacific RR) round house (1906-1954) Locomotive Turntable and fueling rack, oil/water separator	hydrocarbons and lube oils	subsurface impacted by northern CVOC plume, subject of this ROD, LNAPL, surface soils contaminated with metals and oils

AOI #	Description	Potential Contamination	Status
22b	Former UPRR (Union Pacific RR) Roundhouse	hydrocarbons, lube oils, solvents	subsurface impacted by southern CVOC plume, subject of this ROD, LNAPL
23	Mucking lines (UP Fruit Express area)	hydrocarbons, PCBs, metals	risks are below a level of concern for soils
24	identified as a filled channel from photos, was a river meander	multiple	removed from site
25	Day Care Center	multiple	removed from site, not owned by the railroad
26	Oil Sludge Reclamation Area (from former UPRR oil reclamation facility)	petroleum, pH	being addressed under removal authorities, construction activities completed
27	Sludge Disposal Area (from cleaning out Bunker C from tenders in the roundhouse)	petroleum, pH, metals	being addressed under removal authorities, construction activities completed
28	Former Drainage Ditch from roundhouse	solvents, hydrocarbons, metals	risks are below a level of concern in soils
29	Strong's Creek drainage ditch	multiple	risks are below a level of concern in water, PAHs in sediments upstream and downstream of site
30	Durbano Metals, former wastewater treatment location, LUST #8 sites	multiple	subsurface impacted by southern CVOC plume, subject of this ROD, UST removed in 1990⁶
31	Former waste water treatment plant	multiple	merged with AOI-30
32	Oil/water separator, fuel oil storage tank (for cabooses)	petroleum	LUST program, closed 2000, Tank removed in 1990, soils excavated in 1992 ⁷

AOI #	Description	Potential Contamination	Status
33	21 st Street Pond	petroleum, PAHs, PCBs	Addressed under a separate ROD, 2004
34a	Waste water treatment plant of Southern Pacific	petroleum, metals	pond sludges removed, some sludges buried earlier, subsurface also impacted by northern CVOC plume
34b	Southern Pacific UST 1 and UST 2	petroleum, metals	UST 1 was removed, UST 2 is under a building, LUST program, closed ⁸
35	D&RGW RIP Track (RIP = repair in place), kerosene storage	petroleum, metals	risks are below a level of concern, area of spilled soda ash cleaned up
36	D&RGW Roundhouse and storage yard	petroleum, metals, solvents	risks are below a level of concern, subsurface soils contaminated with metals
37	UST 6 and 9	petroleum	Tanks removed in 1990, soils excavated in 1992, LUST program, closed ⁹
38	Southern Pacific Machine shop and fueling rack	petroleum, solvents	shop demolished in 1999, heating oil UST removed 1997, subsurface impacted by northern CVOC plume, LNAPL, subject of this ROD
-	33 rd Street drainage slough	multiple	risks are below a level of concern
-	Gasoline LUST site SPRR3	petroleum, BTEX	LUST program, gasoline tank removed 1997, LNAPL, product recovery, LUST Corrective Action Plan initiated 2000.
-	Gasoline LUST site SPRR5	petroleum	LUST program, closed, Tank removed 1997.
-	Weber River Riparian Zone	multiple, PCBs	risks are below a level of concern

AOI #	Description	Potential Contamination	Status
-	Weber River	multiple, PCBs	risks are below a level of concern
-	DNAPL zone near 21 st Street Pond	petroleum, metals, PCBs	addressed under a separate ROD
-	Ogden River	petroleum, metals, PCBs	risks are below a level of concern

¹Remedial Investigation Report, September, 2003

²TCE - tetrachloroethene

³VOC - volatile organic compound

⁴No Further Action, DERR, UDEQ, Tanks #3 and #4, August 2002

⁵LNAPL - Light Non-Aqueous Phase Layer

⁶No Further Action, DERR, UDEQ, Tank #8, Feb. 2003

⁷No Further Action, DERR, UDEQ, Tank #2, June, 2000

⁸No Further Action, DERR, UDEQ, SPRR Tanks #1 and #2, Jan 2003

⁹No Further Action, DERR, UDEQ, Tanks #6 and #9, June, 2000

TABLE 3
OPERABLE UNITS AT THE RAIL YARD

OU #	Description	Contaminants	Status
OU1	Northern Area, including DNAPL ¹ zone associated with Pintsch Gas plant, Ogden River, and 21 st Street Pond	Heavy hydrocarbons, PAHs, PCBs	interim remedy included pilot DNAPL recovery system tested, fish gate installed, water levels controlled, contamination fenced off, final remedy selected in a separate Record of Decision.
OU2	PCB Contamination	PCB	Source of PCBs did NOT originate at the site, risks below a level of concern

OU #	Description	Contaminants	Status
OU3	Waste Water Treatment Plant formerly used by Southern Pacific Railroad	petroleum, metals	Holding lagoon drained and sludges cleaned out, EPA Emergency Response Action
OU4	Ground Water contamination in yard (except in OU1 area)	solvents, chlorinated hydrocarbons and degradation products	Study and monitoring, source identification, subject of this ROD
6E	Sludge Impoundment Removal Action	heavy hydrocarbons, metals, pH	Addressed using removal authorities. ²

¹DNAPL - Dense Non-Aqueous Phase Layer

²Lagoon C removal in May 2001; Lagoons A and B removal in Nov. 2002

Site Characteristics

1. Site Conceptual Model.

A diagram illustrating the Site Conceptual Model for the entire site was developed in the Risk Assessment Documents (2003) and is shown in Figure 3. For OU4, the groundwater operable unit, the primary concern was chlorinated solvents and their degradation products in the ground water at levels which could present an unacceptable risk to nearby residents and on-site workers if the ground waters were to be used for domestic purposes. Gases and fumes from the water may present a risk if inhaled or ingested.

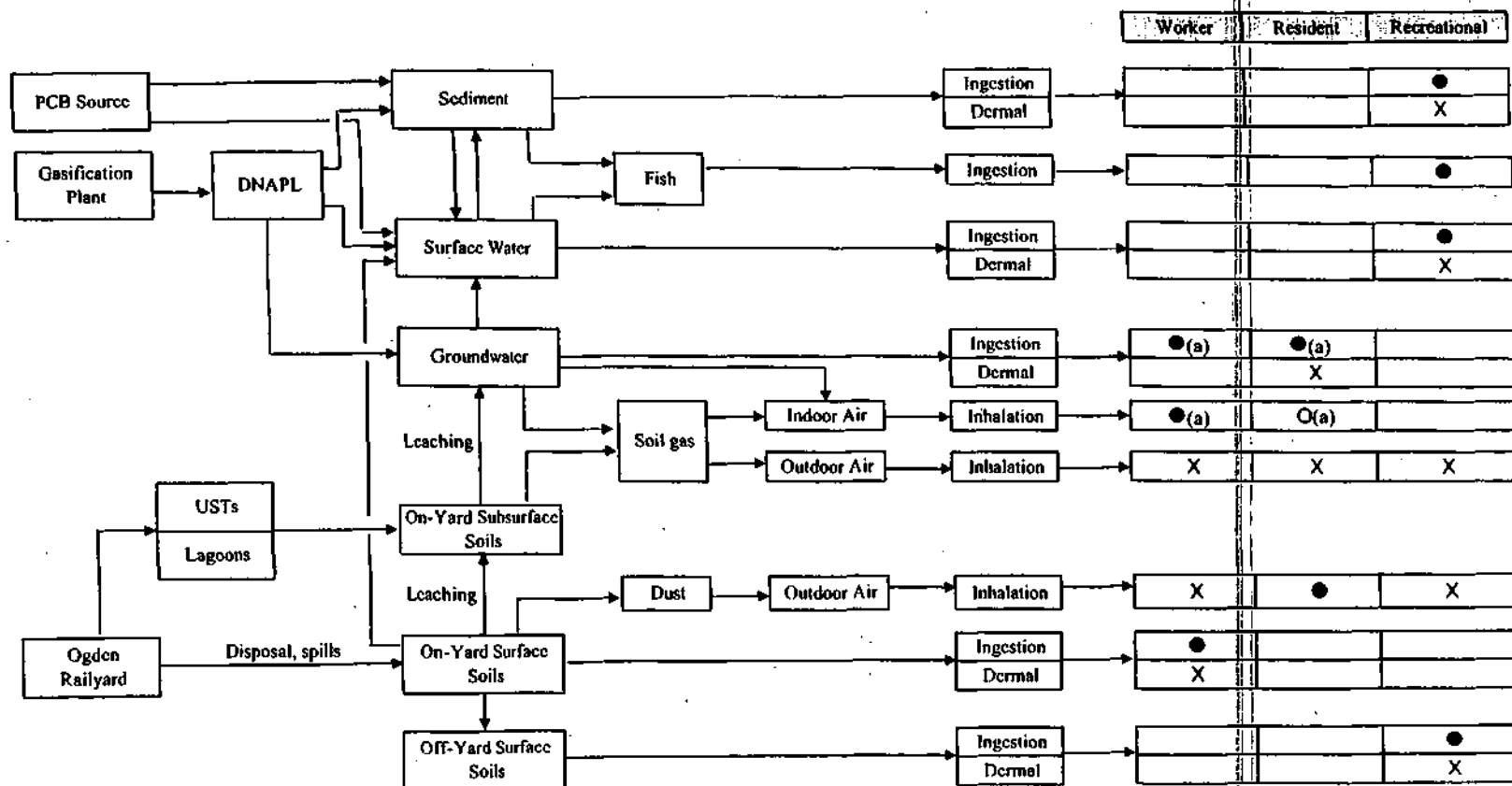
2. Overview (size and topography).

The Ogden Rail Yard Site is approximately 3.5 miles long by ½ mile wide (about 1,120 acres), located just to the west of Downtown Ogden in Weber County, Utah. Because the site has been in active use as a rail yard since 1869, the topography is generally flat to accommodate rail yard activities and service to adjacent industries. The site is bounded on the west side by the Weber River, on the north side by the 21st Street Pond and the Ogden River, on the east side by Wall Ave in the City of Ogden, and to the south by Riverdale Road.

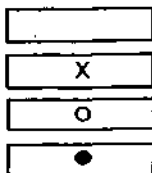
3. Surface and Subsurface features.

The surface and subsurface features of the site were described in the Remedial Investigation Report (Part 1, pp 3-1 through 3-2). In summary, the rail

Figure 3- Site Conceptual Model for Human Exposure



LEGEND



Pathway is not complete; no evaluation required

Pathway is or might be complete, but is judged to be minor; qualitative evaluation

Pathway is or might be complete and could be significant, but data are lacking to support quantitative evaluation; qualitative evaluation

Pathway is or might be complete and could be significant; quantitative evaluation

(a) Pathway is not currently complete but might be complete in the future

yard was built on the eastern side of the Ogden River floodplain. Portions of the site are still within the 500 year floodplain and a few of the areas are within the 100 year flood plain. The rail yard has been filled and graded over time to produce the present level surface of the yard necessary for tracks and railcar switching operations.

Crossing the yard are several creeks and drainages including: Burch Creek, Strongs Creek, the Roundhouse Drainage Ditch, and the 33rd Street Slough. These creeks now flow in culverts under the yard to the Weber River. The Weber River is typically from 7-to-15 feet below the rail-yard surface.

Superimposed upon the generally flat terrain are numerous man-made features. There are two overpasses, the 30th - 31st Street overpass in the middle of the yard, and the 20th - 21st Street overpass at the north end of the yard. Surface structures within the yard changed as rail technology changed. Notable structures included the Union Pacific Roundhouse, the Southern Pacific Machine Shops (both have been demolished, but the concrete foundations still exist), and the Southern Pacific Waste Water Treatment Plant. The yard is crossed with many tracks and rail spurs used for making up trains, switching rail cars, and servicing the local industries close to the yard. Special areas are used for refueling trains (fueling tracks with fuel racks and associated diesel storage facilities).

There are a number of underground structures at the site (in addition to storm drains and creeks passing through culverts under the site, as mentioned earlier). These include underground storage tanks (typically used to store fuel for locomotives), and an industrial sewer system which serviced Southern Pacific locomotive repair and service facilities. The industrial sewer system, installed in the 1950s, carried solvents, oily wastes, and other discharges from the machine shop floor drains, pits, and sumps to the industrial waste water treatment plant. Leaks from this sewer system have been implicated as a cause of the groundwater contamination in the area.

4. Sampling strategy

The sampling of environmental media at the site was done in phases, where the results from the earlier phases were used to focus the sampling for the next phases of the investigations. Phase 1 of the Remedial Investigation for the rail yard was conducted by Union Pacific Railroad as a screening level assessment to determine if environmental contamination was present in 34 areas of interest (AOIs) located throughout the site. The Phase 1 sampling was targeted toward finding the worst cases. If the sampling revealed contamination levels exceeding the site-specific screening levels, the area of interest was included as part of the Phase 2 sampling.

Phase 2 sampling was designed to determine the nature and extent (vertical and lateral) of the contamination. In addition to chemical analyses, Phase 2 work included determination of ground water level fluctuations over the various seasons, determination of the location and continuity of the Alpine Clay layer, and visual examination of the soil borings and borings from well installations for the presence of LNAPL (light non-aqueous phase layer) and DNAPL (dense non-aqueous phase layer) layers and assess any impacts to the Ogden and Weber Rivers. The Phase 2 project was expanded several times to include river sediment, stormwater drainages, the nature of the sludges in and under the former sewage lagoons, and soil-gases above the solvent plumes.

Most of the information needed for remedy selection was collected during Phases 1 and 2. There was a Phase 3 sampling exercise directed toward information needs (data gaps) for the baseline health and ecological risk assessments. The samples collected during this phase included samples from the Ogden and Weber Rivers and riparian habitats along the rivers. Also, investigators conducted experiments to determine if gases from the soils could be emitted to the air and pose a threat to workers and neighbors. This proved not to be an issue.

To gain further information about the riparian corridors next to the Ogden and Weber Rivers, EPA investigators and contractors studied the land adjacent to the rivers, along with the water quality and sediment quality next to the yard.

As part of the Feasibility Study, the Union Pacific Railroad also conducted additional sampling around the footprint of the Southern Pacific Machine Shop to attempt to locate any remaining DNAPL which might be feeding the northern plume. No DNAPL was found suggesting that the industrial sewer might be the source of the chlorinated solvents.

A special evaluation was conducted to determine if natural attenuation was occurring at the solvents plumes and justify alternative concentration limits for the groundwater. They found the original solvents plums a variety of degradation products, suggesting that the solvent plume was undergoing microbial dechlorination, a natural degradation process. This process was modeled - the time to achieve degradation was found to be a strong function of the percentage of source removal. Since the degree of source removal is unknown, the time to predicted remediation was uncertain.

5. Known or suspected sources of contamination.

The major sources of the ground water contamination of the rail yard (to be addressed in this ROD) were the former Southern Pacific Machine Shops and

nearby fueling facilities and the former Union Pacific Roundhouse. At these facilities, chlorinated solvents were used to degrease locomotive and car parts. The largest CVOC plume, associated with the Southern Pacific Machine Shops, also has a LNAPL layer which originated with fueling locations near the machine shops. Because of the elongated shape of the machine shop plume (designated at the Northern CVOC plume), the investigators suspect that an industrial sewer line which transported the spent solvents to the industrial waste water treatment plants has leaked solvents into the ground above the aquifer. Attempts to inspect the integrity of this sewer line via remote television camera were unsuccessful because the sewer appeared to be filled with sludges. The nature of this material is unknown. The integrity of the sewer is also unknown.

At areas of interest which were addressed by other authorities, sources of contaminants were oil/water separators, fuel racks, and fuel storage tanks (both above ground and underground). It is theorized that the oily sludge deposit associated with the AOI 27 Removal Action originated at the Union Pacific Roundhouse, probably from cleaning out Bunker C from tenders and tank cars. (At one time, Union Pacific used locomotives that were fueled by Bunker C, a heavy oil used by industries. One of these locomotives is on display at the Utah State Railroad Museum located at the Ogden Union Station.)

Minor sources of contaminants to the rail yard included spills of fuels and cargo during loading and off-loading from rail cars and locomotives, low amounts of soil gases from soils degassing, stormwater impacts, contaminants left in former river meanders, and discharges from former facilities at the rail yard and surrounding the rail yard. In some locations, the contaminants originated from urban areas adjacent to the rail yard. Certainly traces of these contaminants were found, but they did not rise to a risk concern.

6. Types of contamination and affected media (types, volume, concentrations, RCRA)

The types of contamination of primary concern at the site are solvents and solvent degradation products found in the ground water. The Northern CVOC (Chlorinated volatile organic compounds) plume was associated with the former Southern Pacific Railroad Machine shops. The solvents would have been regulated under RCRA (Resource Conservation and Recovery Act) after 1980, but it is likely that the releases predate the statute. The Southern CVOC plume was associated with the former Union Pacific Railroad Roundhouse. Only degradation products were found there, also suggesting that the releases there predate the RCRA statute. No DNAPL layers were found near either source area despite efforts to look for them. It is likely that the DNAPL layer, if it was present at one time, has been dissipated.

LNAPLs were detected at 5 locations. The composition was consistent with diesel, the fuel used for locomotives. The solvents and degradation products were not found in the LNAPLs suggesting that the LNAPLs originated at a separate (but nearby) source. Remaining contamination from releases of diesel may not be hazardous waste regulated pursuant to Subtitle C of RCRA. The LNAPL layers and pools seem to be stable, neither expanding nor contracting. The estimated volume of the contaminated plumes is given in Table 4.

TABLE 4
VOLUME OF CONTAMINATED PLUMES AT THE OGDEN RAIL YARD SITE
(volume of contaminated water)

Plume location	contaminant	Volume of plume (acre-ft)	Volume of plume (gallons)	Maximum concentration (µg/L)
Northern CVOC	Vinyl chloride	121.4	39.5 Million	3100
	1,2-DCE	35.1	11.4 Million	3700
	1,1-DCE	15.1	4.9 Million	66
	1,1,1-TCA	11.5	3.7 Million	580
	TCE	5.52	1.8 Million	4
	LNAPL (diesel)	16.7	5.4 Million	8800
Southern CVOC	Vinyl Chloride	40	13 Million	2000
	1,1-DCE	23.3	7.9 Million	5.6
	TCE	0.79	0.29 Million	2.5
sludge in sewer	unknown	4710 cu ft	-	unknown

7. Location of contamination and potential routes of migration.

The groundwater contamination from the chlorinated solvent releases is generally found in two locations, one at and down gradient of the former Southern Pacific Machine Shops, and one at and down gradient of the former Union Pacific Roundhouse (see Figure 2). The contaminated groundwater plumes have migrated toward the north-northwest toward the topographic low spot at the 21st Street Pond. The western edge of the northernmost plume (associated with the Southern Pacific Machine Shops) is very near to the Weber River. Currently, the

Weber River is a losing stream at that location and the plume does not discharge there, at least under current conditions. The Ogden River is also a losing stream near the plume, and it is suspected that if the plume should migrate further, it would go toward the 21st Street Pond.

8. Groundwater contamination

Groundwater contamination at the site is found in two locations: the Northern CVOC plume located near and down gradient of the former Southern Pacific Railroad Machine Shops; and the Southern CVOC plume located near the former Union Pacific Railroad Roundhouse. The contamination is present only in the shallow aquifer, a layer of sand, gravels, and fill materials which overlays a thick region-wide clay layer known as the Alpine Clay. The shallow aquifer is unconfined. The hydraulic conductivity of the aquifer sands and gravels is about 0.1 cm/sec (3.28×10^{-3} ft/sec, 283 ft/day). The speed of the water movement has been estimated at 5.7 feet per day toward the north-northwest. The major discharge point for groundwater in this area is the 21st Street Pond, a topographic and water level low point in the area. The rivers which bound the site are both losing streams at this location. The surface water receiving waterbody for the local ground water, the 21st Street Pond, was created when the sands and gravels were excavated for use in local highway projects. Excavations were stopped when the clay layer was encountered. Ground water flow into this pond has been estimated at 620 gallons per minute, 86% of the total inflow to the pond. The volume of the pond is about 30 million gallons.

DNAPL layers could no longer be detected at the site despite an intensive effort to locate them near the suspected source at the former Southern Pacific Machine Shops site. Since this facility was not used after the merger with Union Pacific Railroad in 1996, the release occurred before this date. It is suspected that the solvents which would have created the DNAPL layer were discharged to the Southern Pacific waste water treatment plant via an industrial sewer. The shape of the plume suggests that the integrity of the industrial sewer may have been compromised over the years allowing the solvents to be released gradually overtime. The sewer could not be inspected with any detail via video camera since it was clogged with sludges. LNAPL layers were found at 5 locations in the area near the machine shops. The LNAPL layers did not contain solvents but appeared to be diesel product released during fueling operations near the machine shops. The LNAPL layers ranged from 0.5 feet to 3.5 feet in thickness. Monitoring results of these LNAPL layers indicate that they are not migrating.

Groundwater modeling at the site was done using MODFLOW. Attenuation of the chlorinated solvents and degradation products was modeled using Natural Attenuation Software (NAS, version 1.2.2). The U. S.

Environmental Protection Agency Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater was used to evaluate whether the chlorinated solvents were degrading. The data were quite clear that this process is occurring. The groundwater modeling show that the two plumes containing the solvents and degradation products seem to be stable and are not migrating at present.

9. Site specific factors. The primary site specific factor which requires special consideration during remedy selection is the fact that this site is an operating rail yard with substantial rail traffic using this major east-west and north-south junction point. Tracks overlay about one-third of the plume making those areas of the plume accessible only during brief periods. The plume also goes underneath trackage which services a major grain elevator to the west. The operations at the rail yard prevent construction of infrastructure which addresses the entire plume area. Furthermore access by personnel is also limited during some times of the day when waiting trains block access roads in the yard. Any remedy chosen for this site requiring access to all parts of the plume might require re-routing of major rail lines at substantial costs.

Current and Potential Future Site and Resource Uses

The Ogden Rail Yard is zoned for industrial land use and is still in operation as an active rail yard. Located at a major rail junction, the yard is used for marshalling trains, repairing "bad order" railcars, and is a location where crews of the trains are changed. The Rail Yard is located in a predominantly industrial section of Ogden, although there are a few residential neighborhoods close by. Rail spurs originating at the yard provide rail access to industries such as grain elevators, cold storage facilities, scrap metal dealers, a chemical distributor, and a waste transfer station. The owner of the land, the Union Pacific Railroad, has no plans to abandon any part of the site. In fact, there are plans to expand the yard in the future, by redeveloping currently unused portions of the yard. Between the westernmost tracks and the Weber River is an open space- buffer zone which is currently wildlife habitat. It is possible that a portion of this open space may be used by the City as part of their trail system in the future.

The Utah Department of Natural Resources, Water Rights Division, lists 11 water rights on or near the Ogden Rail Yard Site. A summary of these rights is given in Table 5.

TABLE 5
WATER RIGHTS ON FILE AT THE DIVISION OF WATER RIGHTS

OWNER	DATE	TYPE	USE	POINT OF DIVERSION
Leah Fisher, et al.	1878	Underground and Ogden River	irrigation canal	1 ft from S4 corner, Sec 19, T6N, R1W
Chas C. Rohde	1929	Underground	not given	39 ft from NW corner, Sec 29, T6N, R1W
C. F. Middleton	1931	Underground	not given	S 1325 ft, E4255 ft from NW corner, Sect 30, T6N, R1W
C. J. Bertagnolli	1934	Underground	water use in tourist camp	S 1686 ft, W 1096 ft from NW corner, Sec 30, T6N, R1W
Utah By-Products Co	1960	Underground	industrial processing	S 650 ft, E 64 ft from W4 corner, Sec 29, T6N, R1W
Swift and Co.	1968	Weber River	cooling water to packing plant	S 1040 ft, W 255 ft from E4 corner, Sec 30, T6N, R1W
Oregon Short Line Railroad Co.	1915	Weber River	miscellaneous railroad	N 360 ft, E 225 ft from SW corner, Sec 29, T6N, R1W
Preston Garn	1955	Underground	not given	S 165 ft, E 1254 ft from NW corner, Sec 32, T6N, R1W

OWNER	DATE	TYPE	USE	POINT OF DIVERSION
Utah Canning Co.	1888	Underground	used by the Utah Canning Co.	S 13 ft, E 627 ft from W4 corner, Sec 32, T6N, R1W
Ogden Union Railway and Depot Co.	1850	Weber River	water power for flour mill (Riverdale Mill)	S 500 ft, W 1715 ft from NE corner, Sec 19, T5N, R1W
Charles Hull	1951	Underground	domestic, irrigation, stockwatering	N 1155 ft, W 132 ft from SE corner, Sec 06, T5N, R1W

Although only two of these water rights are owned by predecessors of the Union Pacific Railroad, water rights go with property ownership unless they are specifically reserved for some reason. If the water rights were reserved by the prior owners of the property now owned by the railroad, the water rights do not necessarily come with access to the property. Access agreements would have to be negotiated with the property owner. Therefore, it is concluded that the Union Pacific (or Utah Department of Transportation) owns these water rights by virtue of land ownership or may prevent access to the groundwater simply by denying access to railroad property. The railroad has already announced that they have no plans to develop any of the groundwater resources of the site. They are already connected to municipal water.

Summary of Site Risks

Part 1. Summary of the Human Health Risk Assessment. The chemicals of potential concern found in the areas of highest groundwater contamination (Northern and Southern CVOC plumes, AOIs 22a, 22b, 30, 38) are given in Table 6. Only those compounds which proved to be of some health concern are listed in this table. The Baseline Risk Assessment document includes the entire list of analytes.

TABLE 6
CHEMICALS OF POTENTIAL CONCERN

Exposure Point	Chemical of Concern	Concentrations (ppm)			Detections	Exposure Point Conc.	Statistics
		max	min	mean			
surface soil	arsenic	4.5E+02	2.5E+00	7.0E+01	9/10	1.5E+02	UCL95
ground water	1,2-dichloroethene	3.7E+00	7.0E-04	3.5E-01	24/37	5.6E-01	UCL95
ground water	vinyl chloride	2.3E+00	5.0E-04	3.6E-01	26/38	5.1E-01	UCL95

All the analytical chemistry data used in the risk assessment calculations came from data produced during the Remedial Investigation/Feasibility Studies and were produced using standard analytical methodologies. The chemistry data were then validated to ensure that the procedures were followed. If serious flaws were discovered during validation, the data were rejected and not used. If only a minor problem was discovered, the data were flagged as an estimation.

Exposure assessment. There are two main uses of the site. Most of the site remains an active rail yard, with areas used for switching railcars from one train to another, loading and unloading cargo. During these activities, rail yard workers could be exposed to contaminated soils (by inadvertent ingestion - using dirty hands to eat lunch, for example). Because the contaminants have a certain volatility, it is possible that the ground water could release their gases to the atmosphere at the yard where the workers could inhale these gases. This proved to be a minor exposure route.

There are also buildings on the site which are used as offices and communications centers for the workers. It is possible that ground water at the site could be used inside these buildings. If this should occur in the future, workers would be exposed to contamination in the ground water by drinking it or from inhaling gases which volatilize from the water. The other use for the site along the rivers is riparian habitat/open space. Although this area is not currently used for recreational purposes, it is possible that the area could be used more heavily in the future as the city builds its trail network. Because concentrations of contaminants are low in the riparian zone, this exposure pathway proved not to be significant.

There are several neighborhoods adjacent to the rail yard. Some of the neighbors complained about dust particles which originated at the rail yard and got into their houses. Investigators were concerned about the potential for exposure to residents by inhalation of the rail yard dusts. Also it was possible that ground water from the site could be

delivered to the neighborhood and then possibly used for domestic purposes. Therefore, investigators calculated what the risks would be if the ground water at the site was ever used by the nearby residents. Like the situation on site where railroad workers might use the water, the residents could be exposed to contamination either by inhalation of gases which come out of the water, or by ingestion of the water. At the current time, the ground water is not used by either the railroad for its workers, or by any of the neighbors.

Using proposed exposure pathways, ways that people could be exposed at or near the site, EPA risk assessors calculated how much exposure might occur. This was done using two different scenarios: Central Tendency Estimate (CTE) and Reasonable Maximum Estimate (RME). For example, the Central Tendency Estimate would give an idea of how much fish an average person would normally eat, but the Reasonable Maximum Estimate would give an idea of the maximum number of fish a person could eat. Both methods would tend to overestimate the exposure because the concentrations of contaminants used in the calculation are from the upper end of the concentrations found at the site. In general, standard assumptions used for EPA risk assessments were used for these calculations. The assumptions used for exposures are given in Tables 7 and 8.

TABLE 7
EXPOSURE ASSUMPTIONS USED FOR RECREATIONAL VISITORS
(from Table 3-7, Ogden Rail Yard Risk Assessment)

Exposure Input Parameter	Units	Central Tendency Estimate (CTE)		Reasonable Maximum Estimate (RME)	
		Adult	Child	Adult	Child
General					
Averaging Time, Cancer	yr	70	70	70	70
	days	25550	25550	25550	25550
Averaging Time, Noncancer	yr	15	5	30	10
	days	5475	1825	10950	3650
Body Weight	kg	70	39	70	39
Ingestion of Soil					
Ingestion rate	mg/day	50	100	100	200
Conversion factor	Kg/mg	1E-06	1E-06	1E-06	1E-06
Exposure frequency	days/yr	10	24	20	48
Exposure Duration	yr	15	5	30	10
HIF (noncancer) human intake factor	kg/kg-day	1.96E-08	1.67E-07	7.8E-08	6.67E-07
HIF (cancer)	kg/kg-day	4.19E-09	1.19E-08	3.34E-08	9.53E-08

Exposure Input Parameter	Units	Central Tendency Estimate (CTE)		Reasonable Maximum Estimate (RME)	
		Adult	Child	Adult	Child
Ingestion of Fish					
Ingestion rate (total)	g/day	8	4	25	12.5
Fraction from site		0.2	0.2	0.4	0.4
Conversion factor	kg/g	1E-03	1E-03	1E-03	1E-03
Exposure Frequency	days/yr	350	350	350	350
Exposure Duration	yr	15	5	30	10
HIF (noncancer)	kg/kg-day	2.19E-05	1.95E-05	1.37E-04	1.22E-04
HIF (cancer)	kg/kg-day	4.70E-06	1.39E-06	5.87E-04	1.74E-05
Ingestion of Sediment					
Ingestion rate	mg/day	50	100	100	200
Conversion factor	kg/mg	1E-06	1E-06	1E-06	1E-06
Exposure Frequency	days/yr	10	24	20	48
Exposure Duration	yr	15	5	30	10
HIF (noncancer)	kg/kg-day	1.96E-08	1.67E-07	7.83E-08	6.67E-07
HIF (cancer)	kg/kg-day	4.19E-09	1.19E-08	3.35E-08	9.53E-08
Ingestion of Surface Water					
Ingestion rate	mL/hr	25	25	50	50
Exposure time	hr/day	1	2	1	2
Conversion factor	L/mL	1E-03	1E-03	1E-03	1E-03
Exposure Frequency	days/yr	10	24	20	48
HIF(noncancer)	L/kg-day	9.78E-06	8.34E-05	3.91E-05	3.34E-04
HIF (cancer)	L/kg-day	2.10E-06	5.96E-06	1.68E-05	4.76E-05

TABLE 8
EXPOSURE ASSUMPTIONS USED FOR THE RAIL YARD PORTION
ON-SITE WORKERS
(from Table 3-5, Ogden Rail Yard Risk Assessment)

Exposure Input Parameter	Units	Central Tendency, Adults	Reasonable Maximum, Adults
General			
Averaging Time, Cancer	hrs	70	70
	days	25550	25550
Averaging Time, Noncancer	hrs	5	25

Exposure Input Parameter	Units	Central Tendency, Adults	Reasonable Maximum, Adults
	days	1825	9125
Body Weight	kg	70	70
Ingestion of Ground Water			
Ingestion rate	L/day	0.7	1
Exposure frequency	days/dy	219	250
Exposure duration	yr	5	25
HIF (noncancer)	L/kg-day	86.00E-03	9.78E-03
HIF (cancer)	L/kg-day	4.29E-04	3.49E-03
Inhalation of Indoor Air			
Inhalation rate (indoors)	m ³ /day	10	20
Exposure frequency	days/yr	219	250
Exposure Duration	yrs	5	25
HIF (noncancer)	m ³ /kg-day	8.57E-02	1.96E-01
HIF (cancer)	m ³ /kg-day	6.12E-03	6.99E-02
Ingestion of Soil			
Ingestion Rate	mg/day	50	100
Conversion factor	kg/mg	1E-06	1E-06
Exposure Frequency	day/yr	219	250
Exposure Duration	yr	5	25
HIF (noncancer)	kg/kg-day	4.29E-07	9.78E-07
HIF (cancer)	kg/kg-day	3.06E-08	3.49E-07

Toxicity assessment. The toxicity information used in the risk assessment document (Table 4-1, Risk Assessment Report, Jan. 2003) came from the health literature as compiled in IRIS (Integrated Risk Information System), HEAST (Health Effects Assessment Summary Tables) or from the interim recommendations from EPA's Superfund Technical Assistance Center. The values were also available in a table of toxicity data assembled by USEPA Region 3 (<http://www.epa.gov/reg3hwmd/risk/>).

Risk Characterization. For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where: risk is a unitless probability (e.g. $2E-5$, or 2×10^{-5} , or 0.00002) of an individual's developing cancer;
CDI = chronic daily intake averaged over 70 years (mg/kg-day);
SF = Slope factor, expressed as mg/mg-day, a measure of carcinogenicity)

These risks are probabilities that usually are expressed in scientific notation (e.g. $2E-5$ or 2×10^{-5}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the CTE or RME has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" ~~because it would be in addition to the risks of cancer individuals face from other causes~~ such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all the other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range from site-related exposures is 10^{-4} to 10^{-6} .

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1.0 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemicals of concern that affect the same organ or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI less than 1.0 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects for all contaminants are unlikely. An HI greater than one indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI/RfD}$$

where: CDI = Chronic daily intake
RfD = Reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

Summaries of the risks and hazards calculated for the various significant exposure pathways are given in Tables 9 - 13, with a summary of the calculated risks from all exposure routes given in Table 14:

TABLE 9
 INGESTION OF GROUND WATER BY RAIL YARD WORKERS
 (Values in Bold indicate unacceptable risk via this exposure pathway)

Area of Interest	non-cancer (HI)		cancer (excess cancer risk)	
	CTE	RME	CTE	RME
13 (UST site, now closed)	3E+00	4E+00	5E-05	4E-04
21 (Southern CVOC plume)	1E+00	2E+00	3E-05	2E-04
22a (Northern CVOC plume)	1E+01	2E+01	7E-04	6E-03
22b (Southern CVOC plume)	1E+00	2E+00	1E-04	9E-04
30 (Southern CVOC plume)	2E+00	3E+00	2E-04	2E-03
32 (UST site, now closed)	1E+00	2E+00	2E-05	2E-04
33 (Separate ROD)	2E+00	4E+00	2E-05	2E-04
34 (Removal area)	2E+00	4E+00	7E-05	6E-04
38 (Northern CVOC plume)	3E+00	4E+00	6E-05	5E-04
SPRR3 (UST site)	1E+00	2E+00	1E-04	8E-04
SPRR 5 (UST site)	2E+00	3E+00	5E-05	4E-04

TABLE 10
 INHALATION OF GASES FROM INDOOR USE OF CONTAMINATED GROUND WATER
 BY RAIL YARD WORKERS
 (Values in Bold indicate unacceptable risks via this exposure pathway)

Areas of Interest	non-cancer		cancer	
	CTE	RME	CTE	RME
13 (UST site, now closed)	7E+00	2E+01	3E-06	3E-05
21 (Southern CVOC plume)	1E+00	3E+00	3E-06	3E-05
22a (Northern CVOC plume)	4E+01	9E+01	2E-04	2E-03
22b (Southern CVOC plume)	1E+00	3E+00	2E-05	2E-04
30 (Southern CVOC plume)	7E+00	2E+01	7E-05	8E-04
32 (UST site, now closed)	5E+00	1E+01	9E-06	1E-04
33 (Separate ROD)	3E+02	6E+02	3E-05	3E-04
34 (Removal area)	9E-01	2E+00	1E-05	1E-04
37 (UST sites, now closed)	9E-01	2E+00	8E-08	9E-07
38 (Northern CVOC plume)	1E+01	3E+01	7E-06	8E-05
SPRR3 (UST site)	2E+01	5E+01	2E-05	3E-04
SPRR5 (UST site)	2E+01	4E+01	5E-05	6E-04

TABLE 11
INGESTION OF SOIL BY RAIL YARD WORKERS
(Values in Bold indicate unacceptable risks via this exposure pathway)

Areas of Interest	non-cancer		cancer	
	CTE	RME	CTE	RME
21 (Atlas Steel Salvage Yard)	9E-01	2E+00	2E-05	2E-04
27 (removal site)	6E-02	1E-01	6E-05	7E-04
36 (D&RGW Roundhouse area)	5E-01	1E+00	8E-06	9E-05

TABLE 12
RISKS TO RESIDENTS FROM POTENTIAL INGESTION OF SITE GROUNDWATER
(Values in Bold indicate unacceptable risks from this exposure pathway)

Areas of Interest	Non-cancer		Cancer	
	CTE	RME	CTE	RME
12 (oil/water separator, now removed)	7E-01	1E+00	2E-05	2E-04
13 (UST sites, now closed)	6E+00	1E+01	2E-04	1E-03
20 (Diesel storage, now removed)	9E-01	2E+00	4E-05	3E-04
21 (Southern CVOC plume)	3E+00	6E+00	1E-04	8E-04
22a (Northern CVOC plume)	2E+01	5E+01	3E-03	2E-02
22b (Southern CVOC plume)	2E+00	5E+00	4E-04	3E-03

Areas of Interest	Non-cancer		Cancer	
	CTE	RME	CTE	RME
26 (removal site)	9E-01	2E+00	6E-05	4E-04
27 (removal site)	1E+00	2E+00	2E-05	1E-04
30 (Southern CVOC plume)	4E+00	8E+00	8E-04	6E-03
32 (UST site, now closed)	3E+00	6E+00	8E-05	6E-04
33 (separate ROD)	5E+00	1E+01	8E-05	6E-04
34 (removal site)	5E+00	1E+01	3E-04	2E-03
35 (RIP track)	1E+00	2E+00	3E-05	2E-04
36 (D&RGW Roundhouse)	7E-01	1E+00	2E-05	2E-04
38 (Northern CVOC plume)	6E+00	1E+01	2E-04	2E-03
SPRR3 (UST site)	3E+00	6E+00	4E-04	3E-03
SPRR5 (UST site)	4E+00	8E+00	2E-04	1E-03

TABLE 13
RISKS TO RESIDENTS FROM INDOOR USE OF SITE GROUNDWATER (INHALATION
OF GASES EMITTED BY GROUNDWATER)
(Values in Bold indicate risks via this exposure pathway)

Areas of Interest	non-cancer		cancer	
	CTE	RME	CTE	RME
13 (UST sites, now closed)	1E+01	2E+01	7E-06	5E-05
21 (Southern CVOC plume)	2E+00	4E+00	7E-06	5E-05
22a (Northern CVOC plume)	5E+01	1E+02	5E-04	4E-03
22b (Southern CVOC plume)	2E+00	4E+00	4E-05	3E-04
26 (removal area)	7E-01	2E+01	1E-06	7E-06
30 (Southern CVOC plume)	9E+00	2E+01	2E-04	1E-03
32 (UST site, now closed)	7E+00	2E+01	2E-05	2E-04
33 (Separate ROD)	4E+02	8E+02	7E-05	5E-04
34 (removal area)	1E+00	3E+00	2E-05	2E-04
37 (UST sites, now closed)	1E+00	3E+00	2E-07	2E-06
38 (Northern CVOC plume)	2E+01	4E+01	2E-05	1E-04
SPRR3 (UST site)	3E+01	7E+01	6E-05	5E-04
SPRR5 (UST site)	2E+01	5E+01	1E-04	1E-03

TABLE 14
SUMMARY OF PATHWAYS AND RISKS (WORST CASE LOCATION ON SITE)
(Values in Bold indicate unacceptable risks via this exposure pathway)

Pathway	Location	non-cancer		cancer	
		CTE	RME	CTE	RME
On-site workers					
Surface soil ingestion	21 (Atlas Steel)	9E-01	2E+00^a	2E-05	2E-04^b
Ground water ingestion	22a (North plume)	1E+01 ^c	2E+01^c	7E-04^d	6E-03^d
Inhalation of indoor air	22a (North plume)	4E+01 ^c	9E+01^c	2E-04^f	2E-03^f
Inhalation of soil gases	SF-07 (South plume)	6E-01	1E+00	6E-06	7E-05
Nearby residents					
Ground water ingestion	22a (North plume)	2E+01^g	5E+01^g	3E-03^h	2E-02^h
Inhalation of indoor air	22a (North plume)	5E+01ⁱ	1E+02ⁱ	5E-04^j	4E-03^j
Inhalation of rail yard dusts	Zone A (north part of yard)	2E-03	5E-038E-09		7E-08
Recreational users					
Surface soil ingestion	Weber R.-A (upstream of rail yard)	1E-03	6E-031E-07		1E-06
Ingestion of surface water and sediment	Weber R.-B (south end of yard)	9E-04	4E-039E-08		7E-07

^a70% of the risk comes from arsenic

^b97% of the risk comes from arsenic

^c45% of the risk comes from vinyl chloride

^d97% of the risk comes from vinyl chloride

- *45% of the risk comes from 1,2-dichloroethene
- †52% of the risk comes from vinyl chloride
- ‡45% of the risk comes from vinyl chloride
- ^97% of the risk comes from vinyl chloride
- ‡45% of the risk comes from 1,2-dichloroethene
- ‡52% of the risk comes from vinyl chloride

In summary, the human health baseline risk assessment indicated that:

-
- ~~contaminated ground water is unsuitable for drinking water purposes and gases~~ from the water could pose a threat if the water is used inside the buildings by rail workers or by nearby residents.
 - the riparian zones along the Weber River do not pose a significant risk to recreational visitors along the river.
 - rail yard dusts were not a health risks to nearby residents.
 - there is not a significant risk to industrial workers due to exposure to rail yard soils, except in extreme cases. In that situation, a worker would have to stand stationery in one spot all day, eating with dirty hands. The worker would have to do this every day for several years. This scenario seems very unlikely in the real world.
 - experiments indicated that gases emitted to the atmosphere from degassing of the plume were not a significant risk.
 - EPA has determined that the human health risks present at the site involve future land use and water use scenarios. The risks to current workers and nearby residents are not significant at this time given the current use of the land and water.

Part 2. Ecological Risk Assessment. Investigators evaluated the risks to aquatic species and wildlife living along the riparian corridors through the site. The remainder of the site (the rail yard itself), is not suitable wildlife habitat due to intense human and train activity. However, the rail yard is bounded on the west by the Weber River and its riparian zone, and to the north by the Ogden River and its riparian zone. At present, there is little human activity in those zones. Both terrestrial wildlife and aquatic species have been observed there. In order to evaluate the current ecological risks in these riparian zones, the investigators evaluated different reaches of the two rivers. A summary of the sampling areas is given in Table 15.

TABLE 15
AREAS SAMPLED FOR THE ECOLOGICAL RISK ASSESSMENT

Sampling area	Location	Use in the study
21 st Street Pond	The pond and surrounding areas	Covered in a separate ROD.
Buena Ventura Park Pond	The pond and surrounding areas	Used as a reference location for the 21 st Street Pond.
Ogden River Reach A	Ogden River upstream of Wall Ave.	Used as a reference location for downstream reaches of the Ogden River
Ogden River Reach B	Ogden River between Wall Ave and the 21 st Street Pond	Used to evaluate ecological risks due to the site
Ogden River Reach C	Ogden River between 21 st Street Pond and Weber River confluence	Used to evaluate ecological risks due to the site
Weber River Reach A	Weber River upstream of Riverdale Road	Used as a reference location for downstream reaches of the Weber River
Weber River Reach B	Weber River between Riverdale Rd and 33 rd Street	Used to evaluate ecological risks due to the site
Weber River Reach C	Weber River between 33 rd Street and 24 th Street	Used to evaluate ecological risks due to the site
Weber River Reach D	Weber River downstream of 24 th Street	Used to evaluate ecological risks due to the site.

During the site characterization, a number of contaminants were identified at the site including diesel fuel, oils, petroleum hydrocarbons, chlorinated solvents (and degradation products), metals, and PAHs (polycyclic aromatic hydrocarbons).

The ecological risk assessment consisted of three approaches: comparison of concentrations of media at the site with benchmarks of these media available in the scientific literature; site-specific experiments; and observations of populations of species in the field. Therefore, the assessment and measurement endpoints were hazard indices, toxicity as measured in site-specific tests, and populations changes due to contamination as measured in tests.

Contaminants of Potential Concern: The contaminants of potential concern to aquatic and terrestrial wildlife in the area of the Weber and Ogden Rivers are given in Tables 16A, 16B, and 16C. This list was compiled by comparing the concentrations observed at the site with benchmark values derived from the scientific and regulatory literature. (See Ecological Risk Assessment, Jan. 2003)

TABLE 16A
CHEMICALS OF POTENTIAL CONCERN TO ECOLOGY OF SITE
RANGES AND COMPARISON WITH BENCHMARKS
PART A: SURFACE WATER (ug/L)
(values in Bold are concentrations which exceeded benchmarks)

Chemical	concentrations (ug/L)				benchmark (ug/L)	
	Weber River downstream	Weber River upstream	Ogden River downstream	Ogden R. upstream	aquatics	terrestrial
aluminum	7.5E+02 (9/21)	7.0E+02 (3/5)	7.7E+02 (4/4)	na	8.7E+01	8.11E+03
barium	1.3E+02 (37/37)	1.2E+01 (5/5)	5.8E+01 (5/5)	na	4.0E+00	4.18E+04
cadmium	2.5E+00 (0/37)	2.5E+00 (0/5)	2.5E+00 (3/5)	na	4.52E-01	7.49E+03
lead	6.1E+01 (14/37)	5.0E+00 (0/5)	4.7E+00 (2/5)	na	7.7E+00	8.21E+03
manganese	6.2E+01 (20/21)	3.2E+01 (5/5)	5.7E+01 (4/4)	na	1.3E+00	6.84E+05
selenium	2.0E+01 (0/37)	2.0E+01 (0/5)	4.3E+00 (1/5)	na	5.0E+00	1.55E+03
silver	5.0E+00 (0/30)	2.5E+00 (0/2)	5.0E+00 (1/5)	na	1.34E+00	-
bis2-ethylhexylphthalate	5.0E+00 (1/39)	5.0E+00 (0/5)	5.0E+00 (1/5)	na	3.00E+00	7.9E+03
acetone	4.0E+03 (11/48)	4.0E+00 (1/5)	5.0E+00 (1/3)	na	1.50E+03	77E+04
carbon disulfide	2.5E+00 (1/48)	5.0E-01 (0/5)	2.5E+00 (0/8)	na	9.20E-01	-
dichloromethane	5.8E+03 (22/48)	5.0E-01 (0/5)	2.9E+00 (1/8)	na	2.2E+03	4.55E+04

Several of the chemicals of potential concern are present in the rivers above the screening benchmarks for impacts to aquatic life. However, in most cases, the chemicals were also present above the screening levels upstream of the site. With exception of a few volatile organic compounds, mostly solvents, the contaminants in the rivers do not appear to have originated with the rail yard site.

TABLE 16B
CHEMICALS OF CONCERN TO ECOLOGY OF SITE
RANGES AND COMPARISON WITH BENCHMARKS
PART B: SEDIMENT (mg/kg)

(Values in Bold are concentrations which exceeded benchmarks)

Chemical	Concentration (mg/kg)				Benchmarks (mg/kg)	
	Weber River downstream	Weber River upstream	Ogden River downstream	Ogden River upstream	aquatic	terrestrial
aluminum	6.1E+03 (8/8)	5.9E+03 (2/2)	5.6E+03 (4/4)	na	2.55E+04	3.83E+00
arsenic	4.8E+00 (8/25)	4.0E+00 (2/2)	4.3E+00 (4/5)	na	9.79E+00	2.50E-01
barium	2.3E+02 (25/25)	2.2E+02 (2/2)	1.0E+02 (4/5)	na	4.80E+04	1.72E+01
cadmium	9.3E-01 (9/25)	9.6E-01 (%)	7.4E-01 (1/5)	na	9.90E-01	8.00E-01
chromium	1.1E+01 (24/25)	9.4E+00 (2/2)	1.0E+01 (5/5)	na	4.34E+04	8.30E-01
copper	2.5E+01 (8/8)	1.3E+01 (2/2)	3.8E+01 (4/4)	na	3.10E+01	3.89E+01
lead	6.4E+01 (24/25)	5.3E+01 (2/2)	4.2E+01 (5/5)	na	3.58E+01	9.40E-01
manganese	9.5E+02 (8/8)	4.4E+02 (2/2)	5.3E+02 (4/4)	na	1.67E+03	3.22E+02
mercury	1.2E-01 (9/25)	1.3E-01 (%)	3.3E-02 (2/5)	na	1.80E+01	5.0E-03
vanadium	1.4E+01 (8/8)	1.3E+01 (2/2)	1.3E+01 (4/4)	na	5.70E+01	7.14E-01
zinc	1.4E+02 (8/8)	1.3E+02 (2/2)	7.1E+01 (4/4)	na	1.21E+02	1.20E+01
4,4'-DDE	8.0E-03 (1/30)	6.0E-03 (0/2)	8.4E-03 (0/9)	3.0E-03 (0/6)	3.10E-03	2.00E-03
4,4'-DDT	8.0E-03 (0/30)	6.0E-03 (0/2)	8.0E-03 (2/9)	3.0E-03 (0/6)	4.16E-03	2.00E-03
acenaphthene	2.9E+00 (0/25)	3.0E+00 (0/2)	1.5E+00 (3/28)	3.1E+00 (1/8)	1.36E+00	-
acenaphthylene	2.9E+00 (0/25)	3.0E+00 (0/2)	1.5E+00 (1/29)	3.1E+00 (0/8)	1.47E+00	-
anthracene	2.9E+00 (0/25)	3.0E+00 (0/2)	1.5E+00 (13/28)	3.1E+00 (2/8)	5.72E-02	-
benzo(a)anthracene	2.9E+00 (2/25)	3.0E+00 (0/2)	1.4E+00 (23/28)	3.1E+00 (4/8)	1.02E-01	-
benzo(a)pyrene	2.9E+00 (2/25)	3.0E+00 (0/2)	1.4E+00 (22/28)	1.4E+00 (4/8)	1.50E-01	1.98E+00
benzo(b)fluoranthene	2.9E+00 (2/25)	3.0E+00 (0/2)	1.5E+00 (21/28)	3.1E+00 (4/8)	2.94E+00	-
benzo(ghi)perylene	2.9E+00 (2/25)	3.0E+00 (0/2)	1.5E+00 (25/28)	3.1E+00 (3/8)	1.94E+00	-
benzo(k)fluoranthene	2.9E+00 (1/25)	3.0E+00 (0/2)	1.5E+00 (20/28)	3.1E+00 (4/8)	2.94E+00	-
chrysene	2.9E+00 (5/25)	3.0E+00 (0/2)	1.4E+00 (24/28)	3.1E+00 (4/8)	1.66E-01	-
dibenz(a,h)anthracene	2.9E+00 (0/25)	3.0E+00 (0/2)	1.5E+00 (9/28)	3.1E+00 (1/8)	3.30E-02	-

Chemical	Concentration (mg/kg)				Benchmarks (mg/kg)	
	Weber River downstream	Weber River upstream	Ogden River downstream	Ogden River upstream	aquatic	terrestrial
fluoranthene	2.9E+00 (3/25)	3.0E+00 (0/2)	1.4E+00 (25/28)	3.1E+00 (6/8)	4.23E-01	-
fluorene	2.9E+00 (0/23)	3.0E+00 (0/2)	1.4E+00 (3/28)	3.1E+00 (2/8)	7.74E-02	-
naphthalene	2.9E+00 (0/33)	3.0E+00 (2/4)	1.5E+00 (2/29)	3.1E+00 (6/8)	1.76E-01	-
phenanthrene	2.9E+00 (2/25)	3.0E+00 (0/2)	1.5E+00 (21/28)	3.1E+00 (4/8)	2.04E-01	-
pyrene	2.9E+00 (7/25)	3.0E+00 (0/2)	1.5E+00 (25/28)	3.1E+00 (6/8)	1.95E-01	-
aroclor 1254	7.0E-02 (0/25)	7.5E-02 (0/2)	5.5E-01 (1/29)	4.7E-02 (1/9)	5.98E-02	1.11E-01
aroclor 1260	7.0E-02 (0/25)	7.5E-02 (0/2)	4.2E+00 (14/19)	4.7E-02 (0/10)	5.98E-02	7.10E-02
bis(2-ethylhexyl)phthalate	1.9E+00 (20/25)	3.0E+00 (1/2)	7.0E+00 (7/12)	3.0E+00 (0/2)	5.22E-02	9.20E-01
Butylbenzylphthalate	2.9E+00 (1/25)	3.0E+00 (0/2)	1.5E+00 (1/11)	3.1E+00 (0/2)	9.69E-01	-
dibutylphthalate	2.9E+00 (1/25)	3.0E+00 (0/2)	1.5E+00 (0/12)	3.1E+00 (0/2)	6.63E-01	9.00E-02
phenol	2.9E+00 (2/25)	3.0E+00 (0/2)	1.5E+00 (0/11)	3.1E+00 (0/2)	2.32E-02	5.00E-02
1,1-dichloroethane	5.2E-03 (1/36)	2.5E-03 (0/5)	5.0E-03 (0/4)	na	5.64E-03	2.00E-02
acetone	3.9E-01 (24/36)	1.3E-01 (0/5)	1.0E-02 (0/4)	na	8.1E-02	-
acrylonitrile	2.5E-02 (1/28)	1.8E-02 (0/3)	2.5E-02 (0/3)	na	2.04E-03	-
methylbromide	5.0E-03 (1/36)	1.0E-02 (3/5)	5.0E-03 (0/4)	na	3.23E-03	-
carbon disulfide	5.2E-03 (9/36)	7.0E-03 (3/5)	5.0E-03 (0/4)	na	2.46E-04	-
methylisobutylketone	6.4E-03 (1/36)	5.0E-03 (0/5)	1.0E-02 (0/4)	na	9.69E-03	-
toluene	8.8E-01 (22/36)	1.9E+00 (5/5)	5.0E-03 (0/4)	na	2.79E-03	5.15E+01
xylene (t)	1.0E-02 (2/28)	1.0E-02 (1/3)	1.5E-02 (0/3)	na	5.03E-03	4.16E+00

This table suggests numerous exceedances of benchmark concentrations in the sediments of the Weber and Ogden Rivers. Some, if not most, of these exceedances may be an artifact, since there were exceedances on numerous occasions when the compound was not actually detected in the sediments. The exceedances were typically found both upstream and downstream of the site.

TABLE 16C
CHEMICALS OF CONCERN TO SITE ECOLOGY
RANGE AND COMPARISON TO BENCHMARKS
PART C: SOILS

(Values in Bold are concentrations which exceeded benchmarks)

chemical	concentrations (mg/kg)				benchmarks (mg/kg)	
	Weber River downstream	Weber River upstream	Ogden River downstream	Ogden River upstream	plants and inverts	wildlife
antimony	8.0E+00 (0/34)	7.7E+00 (2/2)	na	na	3.00E+00	2.48E-01
4,4'DDE	8.0E-03 (0/14)	1.8E-03 (1/1)	na	na	-	2.00E-03
dibutylphthalate	1.2E+00 (0/51)	1.0E+00 (4/11)	na	na	2.00E+02	9.00E-02
tetrachloroethene	7.0E-03 (2/48)	4.0E-03 (0/11)	na	na	2.00E-03	1.39E+00

Although antimony would appear to be a problem in the sediments and soils of the Weber River, the concentrations of antimony is about the same both upstream and downstream of the site and are within the background concentrations of metals in Utah as demonstrated in Table 17. For the organics, the calculations suggested that 4,4'DDE and dibutylphthalate were above the wildlife benchmark at the downstream Weber River location, but there were no detections of these chemicals actually found there. Tetrachloroethene was found in the river sediments at two locations at levels exceeding the benchmark. This may have been a relic of a past discharge of solvents at the site from former waste water treatment plant on the river. There were no detections of PCE found in the sediments.

TABLE 17
COMPARISON OF BACKGROUND CONCENTRATIONS OF METALS
WITH CONCENTRATIONS AT 21st STREET POND
(From Ecological Risk Assessment, 2002)

Chemicals	Utah Background Range (mg/kg)	Toxicity Benchmark (mg/kg)	Weber River downstream	Weber River upstream
Aluminum	15,000 - 100,000	50	5455	9745
Arsenic	1.5 - 48	10	3.8	13
Barium	150 - 1,500	160	100	145
Chromium	15 - 150	0.40	9	15
Copper	7 - 100	36	24	48
Iron	7,000 - 100,000	200	7640	11965
Mercury	0.01 - 4.6	0.1	0.13	1.40
Manganese	100 - 1000	100	219	413
Lead	5 - 700	50	77	512

Chemicals	Utah Background Range (mg/kg)	Toxicity Benchmark (mg/kg)	Weber River downstream	Weber River upstream
Antimony	1.1 - 4	3.0	1.27	4.55
Selenium	0.1 - 1.5	0.70	0.94	0.23
Vanadium	20 - 300	2.0	13	19
Zinc	20 - 2,000	50	103	546

Table 17 demonstrates that all of the inorganics are well within the range reported for background concentrations. The table also indicates that, with one exception (selenium), all of the inorganics in the sediments were actually higher at the upstream sampling location.

The Ecological Risk Assessment indicated that the agencies should not be too concerned about a few samples which had components exceeding the benchmark. Investigators indicated that concern is not warranted until 20% or more of the samples are above the benchmark.

Having identified the Chemicals of Concern through comparison with benchmarks, the ecological investigators proceeded to look at representative species present at the site (for which reference toxicity information was available) and then calculated the dose these species would get living and feeding at the site. A summary of the comparison expressed in Hazard Index is given in Table 18.

(Hazard Index = calculated dose at site/reference dose where effects have been noticed). Any Hazard Index greater than 1.0 suggests that effects due to site exposure may be occurring.

TABLE 18A
HAZARD INDICES OF REPRESENTATIVE SPECIES AT THE OGDEN AND WEBER RIVERS

Chemical of Concern	Belted Kingfisher				American Robin				Mallard Duck			
	Weber River down*	Weber River up	Ogden River down	Ogden River Up	Weber River down	Weber River up	Ogden River down	Ogden River up	Weber River down	Weber River up	Ogden River down	Ogden River up
Aluminum	1E-01	1E-01	6E-02	-	5E-01	8E-01	-	-	6E-02	6E-02	3E-02	-
Arsenic	3E-03	1E-03	2E-03	-	3E-02	8E-02	-	-	2E-03	7E-04	8E-04	-
Lead	2E-02	2E-02	1E-02	-	6E-01	4E+00	-	-	2E-02	2E-02	2E-02	-
Mercury	2E-02	3E-02	9E-03	-	7E-03	8E-02	-	-	1E-02	2E-02	4E-03	-

TABLE 18B
HAZARD INDICES OF REPRESENTATIVE SPECIES

Chemical of Concern	Mink				Masked Shrew			
	Weber River downstream	Weber River upstream	Ogden River downstream	Ogden River upstream	Weber River downstream	Weber River upstream	Ogden River downstream	Ogden River upstream
aluminum	4E-01	4E-01	2E-01	-	4E+01	8E+01	-	-
arsenic	5E-03	2E-03	2E-03	-	7E-01	2E+00	-	-
lead	1E-03	8E-04	7E-04	-	4E-01	3E+00	-	-
mercury	4E-03	5E-03	1E-03	-	3E-01	4E+00	-	-

Very few exceedances of concentrations known to impact these species were found. The only chemicals were aluminum (which exceeded the benchmark at both upstream and downstream Weber River locations for masked shrew) and arsenic, lead and mercury at only the upstream Weber River locations for masked shrew. None of these exceedances appear to be related to the rail yard.

The second approach used at the site was site-specific toxicity tests. Some toxicity (24 - 26% mortality) was found in the Weber River near the location of the former Southern Pacific industrial waste water treatment plant. No toxicity was found elsewhere.

The third approach used population surveys. This technique which is typically used for streams and rivers where the benthic organisms live within the sediments. The benthic community in the Weber and Ogden Rivers were not impacted at any location.

Based on the weight of evidence, the investigators summarized their results in a Site Conceptual Model (for the entire site) as shown in Figure 4. (Table 4-1 in the Risk Assessment Report, Jan. 2003). A summary of the findings regarding the rivers adjacent to the site is given in Table 19.

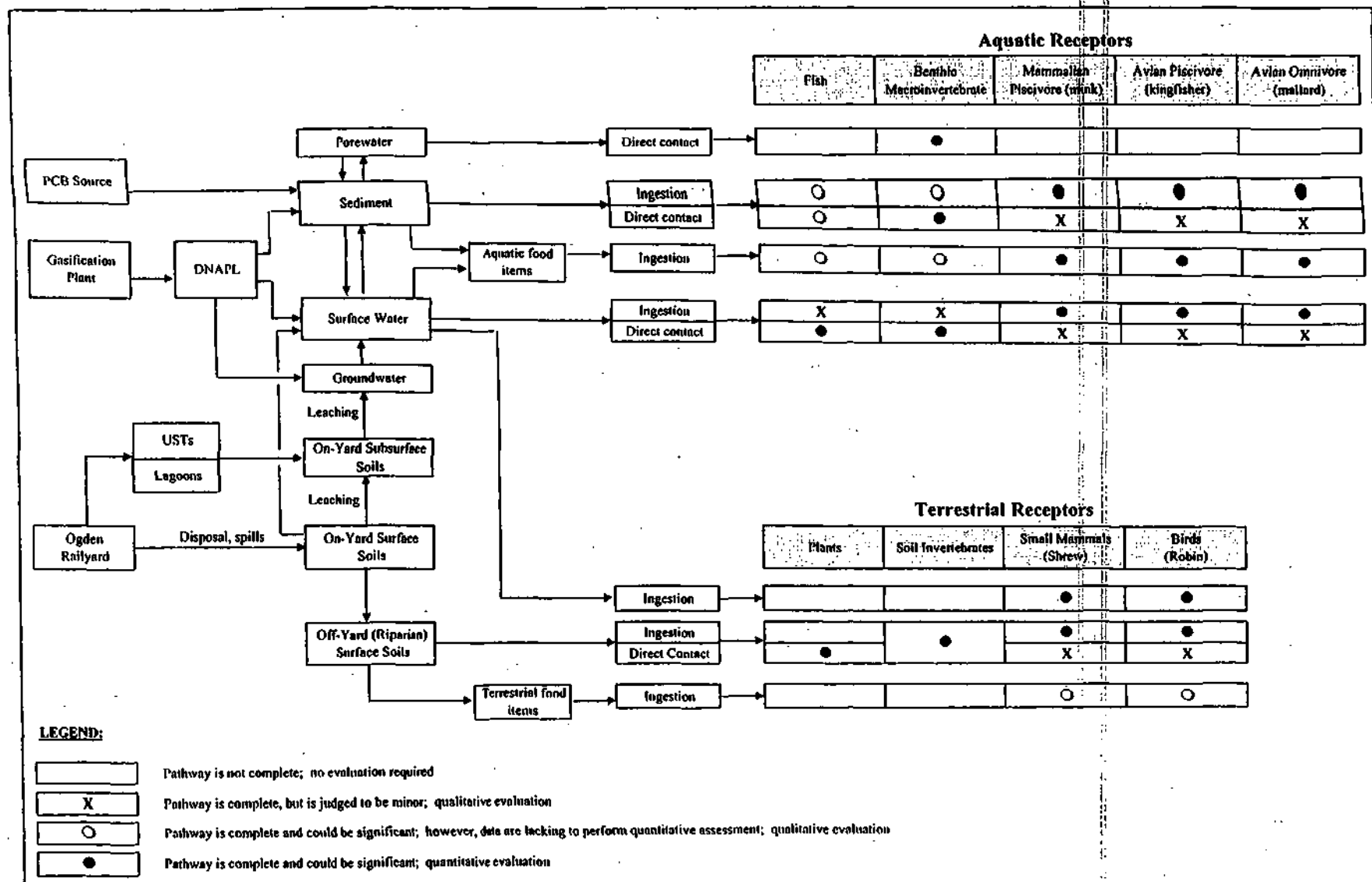


Figure 4
Site Conceptual Model for Ecological Exposure
Baseline Ecological Risk Assessment for the Ogden Railyard Site

TABLE 19
SUMMARY OF ECOLOGICAL RISK CONCLUSIONS
OGDEN AND WEBER RIVER CORRIDORS

Evidence	Conclusions
RISKS TO AQUATIC LIFE DIRECT CONTACT WITH SURFACE WATER	
Comparison to Benchmarks	<p>For inorganics, concentrations were greater than benchmarks at the Ogden and Weber Rivers, but also at an uncontaminated reference locations upstream, and concentrations were not above background.</p> <p>For organics, several solvents were of potential population significance at the downstream locations of the Ogden and Weber Rivers.</p>
RISK TO AQUATIC LIFE DIRECT CONTACT WITH SEDIMENT	
Comparison to Benchmarks	<p>For inorganics, several concentrations were greater than benchmarks at Ogden and Weber Rivers, but also at the reference locations upstream. Contamination likely not associated with the site.</p> <p>For organics, most of the PAHs in the sediments exceeded the benchmarks for aquatic life, both downstream and upstream of the site. It is unlikely that the PAHs in the river sediments are associated with the site. PAHs are common components of urban runoff. Risks from Aroclors 1254 and 1260 (PCBs) were above benchmarks at a population level at a stretch of the Ogden River near the 21st Street Pond. It was later discovered that the PCBs did not come from the rail yard. Risks from 4,4'-DDE and 4,4'-DDT were slightly higher at the downstream river locations but these are pesticide residues and are likely non-site related. The pesticides likely came from former use of this area for agricultural purposes. Xylenes and toluene were above the level of concern for upstream and downstream locations and could be unrelated to the site.</p>
Direct Toxicity Testing	Low toxicity (24 - 26% mortality) was found on the Weber River close to the former Southern Pacific waste water treatment plant. No toxicity was found elsewhere.
Population Observations	The benthic community in the Weber River was not impacted at any location.

Evidence	Conclusions
Calculations from fish body burdens	Risks from PCBs in the river fish were low, except for RME assumptions.
RISKS TO TERRESTRIAL PLANTS AND SOIL ORGANISMS	
Comparison to Benchmarks	For inorganics, antimony was above a level of concern both upstream and downstream of the site, but antimony was well within background levels for the area. The benchmark was probably overly conservative.
	For organics, PCBs were above a level of concern in soils near the 21 st Street Pond, but these appear to be related to abandoned meanders of the Ogden River near the Pond.
RISKS TO WILDLIFE	
Comparison to Benchmarks	<p>For piscivorous birds (e.g. kingfisher), risks were insignificant.</p> <p>For passerine birds (robin), there were no risks associated with the area.</p> <p>For aquatic birds (mallard duck), there were no risks associated with the area.</p> <p>For mammalian insectivores (masked shrew), there are risks calculated for aluminum at both upstream and downstream Weber River locations. Risks were found for arsenic, lead and mercury at only the upstream location. The benchmark concentration is likely overly conservative, and it is unlikely that these metals are associated with the site.</p> <p>For piscivorous mammals (mink) risks appear to all be beneath a level of concern.</p>
PCB toxicity calculations	Total Aroclor method suggests no reason for concern for PCBs in wildlife.

Although the immediate concern for the baseline risk assessment was to determine current risks in the rivers, the concern for the future is what would happen should the ground water begin to discharge into the rivers. EPA evaluated the potential threat, assuming that groundwater significantly impacted the chemical composition of the river.

TABLE 20
COMPARISON OF CONTAMINANTS IN GROUND WATER
WITH BENCHMARKS FOR SURFACE WATER (units are in µg/L)
(Values in Bold indicate concentrations in excess to benchmarks)

	current edge of plume (34MW8)	center of plume (38MW12)	aquatic benchmark	terrestrial benchmark
1,1,1-trichloroethane	-	2830	110	437000
1,1-dichloroethane	107	1090	47	12500
1,1-dichloroethene	2	190	25	44900
1,2-dichloroethene	6.5	3930	910	12500
selenium	2.7	10.6	5	1550
silver	2.2	2.1	1.3	-
trichloroethene	0.8	297	47	2940
xylenes	-	23	13	8830

These calculations suggest that should the degradation products of the solvents at concentrations near the center of the northern plume reach the rivers or the pond, the concentrations could be a risk to aquatic life. At concentrations near the edge of the plume, the concentrations are low enough not to present a problem.

In summary, to prevent an unacceptable risk to human health, the ground water should not be used for indoor purposes while remediation is ongoing. To prevent an unacceptable risk to aquatic life, the ground water should not migrate to the receiving waters, the rivers or the 21st Street Pond.

Remedial Action Objectives

The Remedial Action Objectives for the ground water Operable Unit 4 are:

1. Protect unacceptable exposure risk to current and future human populations presented by direct contact, inhalation, or ingestion of contaminated ground water;
2. Prevent potential future ground water plume migration as necessary to protect current beneficial uses and potential beneficial uses of ground water in the vicinity of the site, and to be protective of surface waters and their designated uses;

3. Restore the ground water to beneficial uses (as technically practicable);
4. Treat, contain, or remove sources of ongoing contaminant loading to the ground water plume.

Description of Alternatives

The Ogden Rail Yard Feasibility Study describes five different alternatives for cleanup of the two ground water plumes at the site (Operable Unit 4). (No cleanup options were considered for the remainder of the site because these were either addressed using other authorities or were at locations where few significant environmental problems were found.)

Alternative 1: No further action. No monitoring, control or treatment of ground water is performed.

Alternative 2: Monitored Natural Attenuation.

- On a semi-annual basis, samples will be collected from 20 north and south plume monitoring wells and analyzed for VOCs. Water level gauging would be performed at 50 wells to determine direction and gradient of ground water flow.
- On a yearly basis, a sample would be taken from the 21st Street Pond along the discharge (south) side of the pond to confirm that vinyl chloride levels in the pond do not present a risk.
- Every other year, samples would be collected from 9 north plume monitoring wells and analyzed for geochemical parameters to assess that the conditions necessary for natural attenuation still persist.
- Data would be analyzed for concentration vs. time, concentration vs. distance and the progress of Monitored Natural Attenuation on an annual basis. The data and the analysis would be presented to EPA in an annual report. This report should also include the status of the monitoring wells.
- Once every five years, a summary report of data collected over the previous 5 years would be submitted to EPA. This report would also include an evaluation of an institutional control plan for the site. (The institutional control plan must prevent access to the ground water.)
- If for some unforeseen reasons, plume concentrations were to increase near the 21st Street Pond, an investigation would be performed to determine

whether a new release has occurred. If the release is due to rail yard activities, UPRR would provide a corrective action plan to the agencies within 60 days of the exceedances.

Alternative 2, Monitored Natural Attenuation, is included in all of the action remedies (Alternatives 2 - 6). This natural process which includes anaerobic dechlorination of the original solvents, has been occurring for at least 10 years, perhaps for much longer. The fact that the plume is remaining stable is due to this process. Alternative 2 does not include any efforts at source control, such as in Alternatives 3, 4, and 6, or perimeter protection such as in Alternative 5. For this reason, it will take this natural remedial process many years, perhaps 100 years or longer, to fully degrade the solvents. (See Appendix C in the Feasibility Study. The time for cleanup is a function of the amount of source material and the degree to which the source is removed, i.e., with 90% removal of the source, cleanup times with natural attenuation would be 32 years. With 4000 pounds of unremoved source material, the time to remediation approaches 100 years.) As Alternatives 3, 4, 5, and 6, this remedy includes a monitoring component which would allow additional responses to be planned should the plume begin expansion or change directions.

The expected outcome for this remedy is that the plume of chlorinated hydrocarbons will remain stable over time, neither increasing nor decreasing in size or concentrations, until the source feeding the plume disappears. Current data show that the southern plume is shrinking. The land can continue in its present use as a rail yard (or other industrial use). The water will not be useable for drinking or indoor uses, but presently, the water is not used for this. The railroad may prevent others, even those with water rights, from developing the ground water. The main difficulty with this remedy is the time it takes to restore the ground water.

Alternative 3: Focused source removal with monitored natural attenuation.

- The activities and contingencies listed in Alternative 2, including monitoring, institutional controls, and implementation of a corrective action plan if the plume starts to move.
- Removal of industrial sewer, testing of sludges inside and disposal of the sludges in an appropriate facility.
- Removal of any contaminated soils underneath the industrial sewer as indicated by presence of vapors or staining

Alternative 3 contains natural attenuation as a major component of the remedy, as the other action alternatives (2, 4, 5, and 6). In addition, it includes an effort to address at least one of the solvent sources feeding the plume, which is also a component of

Alternatives 4, 5 and 6. Because at least some of the source materials would be removed with this alternative, the time for remediation would be shorter than Alternative 2, which has no source removal components. As the other natural attenuation alternatives (2, 4, 5, and 6), this remedy includes a monitoring component which would allow additional responses to be planned should the plume begin to expand or change directions.

The expected outcome for this remedy is that the plume of chlorinated hydrocarbons would begin to decrease over time both in size and concentrations. The land can continue in its present use as a rail yard (or other industrial use). The water will not be useable for drinking or indoor uses while the natural attenuation process is ongoing, but presently the water is not used for this. The railroad may prevent others, even those with water rights, from developing the ground water. Although the source removal will reduce the time it takes to restore the aquifer, it will still take a long time (perhaps 30 years, depending on the percentage of the total source removed).

Alternative 4: Aggressive Source Area remediation with monitored natural attenuation.

- The activities and contingencies listed in Alternative 3, including monitoring, institutional controls, implementation of a corrective action plan if the plume starts to move, and removal of the industrial sewer and any impacted soils underneath the sewer.
- Air sparging in a 9 acre area east of the railroad tracks at AOI 22; air sparging in a 3 acre area between the railroad tracks at AOI 34 to flush out vapors from the solvents and degradation products and add oxygen to the aquifer to enhance aerobic natural attenuation at the northern plume.
- Air sparging in an 6.5 acre area northeast of AOI 21 to add natural attenuation at the southern plume.
- Collection of vapors being flushed out of the aquifer.

Alternative 4 contains natural attenuation as a major component of the remedy, as the other action alternatives (2, 3, 5, and 6). In addition, it includes an effort to address the solvent sources feeding the plume, which is also a component of Alternatives 3, 5, and 6. Because at least some of the source materials would be removed with this alternative, the time for remediation would be shorter than Alternative 2, which has no source removal components. As the other natural attenuation alternatives (2, 3, 5, and 6), this remedy includes a monitoring component which would allow additional responses to be planned should the plume begin to expand or change directions.

The expected outcome for this remedy is that the plume of chlorinated

hydrocarbons would begin to decrease over time both in size and concentrations. The land can continue in its present use as a rail yard (or other industrial use). The water will not be useable for drinking or indoor uses while the natural attenuation process is ongoing, but presently the water is not used for this. The railroad may prevent others, even those with water rights, from developing the ground water. Although the source removal will reduce the time it takes to restore the aquifer, it will still take a long time (10s of years, depending on the percentage of the total source removed, see Feasibility Study, Appendix C).

Alternative 5: Perimeter Ground Water Treatment

- The activities and contingencies listed in Alternative 3, including monitoring, institutional controls, implementation of a corrective action plan if the plume starts to move, and removal of the industrial sewer and any impacted soils underneath the sewer.
- Installation of an air sparging wall along the edges of the plume adjacent to the Weber River and 21st Street Pond. One wall would be 1050 feet long parallel to the Weber River in the vicinity of AOI 34; the other wall would be 350 feet perpendicular to the plume at AOI 34.
- Vapors degassing from the plume will not be collected or treated since there are no nearby residences or industrial buildings.

Alternative 5 contains natural attenuation as a major component of the remedy, as the other action alternatives (2, 3, 4, and 6). In addition, it includes an effort to address the solvent sources feeding the plume, which is also a component of Alternatives 3, 4 and 6. Because at least some of the source materials would be removed with this alternative, the time for remediation would be shorter than Alternative 2, which has no source removal components. As the other natural attenuation alternatives (2, 3, 4, and 6), this remedy includes a monitoring component which would allow additional responses to be planned should the plume begin to expand or change directions. Unlike the other action alternatives, Alternative 5 includes a barrier wall at the northern end of the plume to prevent any further migration of contaminants in that direction. This may or may not provide extra protectiveness for the receiving waters, the 21st Street Pond and the Weber River.

The expected outcome for this remedy is that the plume of chlorinated hydrocarbons would begin to decrease over time both in size and concentrations. The land can continue in its present use as a rail yard (or other industrial use). The water will not be useable for drinking or indoor uses while the natural attenuation process is ongoing, but presently the water is not used for this. The railroad may prevent others, even those with water rights, from developing the ground water. Although the source

removal will reduce the time it takes to restore the aquifer, it will still take a long time (perhaps 30 years, depending on the percentage of the total source removed). There is some protection for the river and the 21st Street Pond while the remediation is ongoing.

Alternative 6: Aggressive Source Area remediation and active ground water remediation

- The activities and contingencies listed in Alternative 3, including monitoring, institutional controls, implementation of a corrective action plan if the plume starts to move, and removal of the industrial sewer and any impacted soils underneath the sewer.
- Installation of an air sparging system throughout the northern and southern plumes.

Alternative 6 contains natural attenuation as a component of the remedy, as the other action alternatives (2, 3, 4, and 5), but does not rely on it to the same degree as the others. Alternative 6 is also more likely to find and address most of the sources since air sparging would occur throughout the plume areas. Treatment time would be shorter than the other alternatives, perhaps less than 10 years. The cost is greater than any of the other alternatives, but it is unknown what levels of contaminants might be achieved.

The expected outcome for this remedy is that the plume of chlorinated hydrocarbons would decrease both in size and concentrations. However, it is not known without experimentation exactly how much of the chlorinated compounds could be removed in this way and whether enough could be removed to allow full use of the water for drinking and indoor purposes. The land can continue in its present use as a rail yard (or other industrial use). In addition, the land might be suitable for redevelopment following cessation of rail activities in the future. The water may or may not be useable for drinking or indoor uses depending on the effectiveness of the remedy, but presently the water is not used for this. The railroad can prevent others, even those with water rights, from developing the ground water. The most significant problem with this remedy is that the extensiveness of the activity at the surface of the yard could interfere with railroad operations at the site. Any compromise on the level of remedial activity for the sake of non-interference with the railroad tracks could render this approach unsatisfactory. This remedy would be more implementable at a non-operational site.

Comparative Analysis of Alternatives

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and

describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

Alternative 1 is not protective of human health because it does not control access to the ground water. The risk assessment clearly demonstrates that the ground water presents a threat to anyone drinking the water or being exposed to fumes which would be emitted if the water is used for indoor purposes. Alternative 1 is also not protective of the environment should the plume move toward either the Weber River or the 21st Street Pond.

Alternatives 2 - 6 are protective of human health and the environment through use of engineering controls, contingency plans, and/or institutional controls. Alternative 5 provides an extra measure of protection for the nearby potential receiving water bodies.

2. Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, which not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for invoking a waiver.

In this case, all of the alternatives have the potential to achieve drinking water standards in the aquifer. This will take a long time. Instead, the near-term goal of the

ground water cleanup will be at concentrations protective of the receiving water (21st Street Pond, Weber River, Ogden River). These concentrations will be the Water Quality Standards applicable to the rivers and ponds. All of the action alternatives (Alternatives 2 - 6) would meet ARARs using the appropriate Water Quality Standards of Utah. Alternative 1 might also meet ARARs but there would be no way to know this because the plumes are not monitored.

3. Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

All of the action alternatives would be effective long term. While the natural attenuation process is ongoing (Alternatives 2 - 5), institutional controls would prevent access to the groundwater. Since the Union Pacific Railroad owns the land, it can ensure that the ground water is not used either by itself or others. The Utah Environmental Institutional Control Act (U.A.C § 19-10-101 *et seq.*) can increase the effectiveness of institutional controls at all sites. In this particular case, the institutional controls would be very effective. Alternative 1 might be effective, but verifying this would be impossible due to lack of monitoring. There is some degree of uncertainty about the effectiveness of Alternative 6.

4. Reduction of Toxicity, Mobility or volume through treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as a part of the remedy.

All of the action alternatives (Alternatives 2 - 6) would reduce toxicity and volume of the contaminated groundwater plumes. Alternatives 3-6, which contain source control measures, would reduce the size and concentrations of contaminants in the plume at a faster rate than with monitored natural attenuation alone. Alternative 1 might also reduce the volume of the plume, but there is no way to assess this without monitoring.

5. Short Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

All of action alternatives (Alternatives 2 - 6) would be effective in the short term, but the time required for remediation would be the longest for Alternative 2, which, unlike the other alternatives, has no source control component. The time of remediation depends on the degree to which the source is removed. Since the nature and extent of the source is currently unknown, the degree of effectiveness for the alternatives is an estimate. Because the entire plume area is treated in Alternative 6, it is likely that it would be the fastest. There could be releases to the atmosphere using Alternatives 4 - 6 which could pose a threat to workers who are unprotected by PPE. This is unlikely to be a problem off-site. In addition, the air-sparging alternatives (Alternatives 4 - 6) would aerate the plume area. This is a concern because the natural attenuation process appears to be an anaerobic dechlorination microbial process. This process could be negatively influenced if air is added to the system.

6. Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

All of the alternatives are implementable and do not require specialized equipment, supplies, or personnel.

7. Cost

The estimated present worth costs for the alternatives, not including the No Action Alternative, range from \$550,000 for Alternative 2 to \$6,900,000 for Alternative 6. The cost of each alternative increases as the degree of ground water treatment increases. Cost summaries can be found in Table 21.

TABLE 21
SUMMARY OF COSTS FOR THE ALTERNATIVE REMEDIES

Alternative	Capital Costs	Annual O+M Costs	NPV O+M Costs	Total NPV costs
Alternative 1 - No action	0	0	0	0
Alternative 2 - Monitored Natural Attenuation	0	\$10,500	\$550,000	\$560,000

Alternative 3 - Focused Source Removal and Monitored Natural Attenuation	\$350,000	\$10,500	\$550,000	\$900,000
Alternative 4 - Aggressive Source Removal and Monitored Natural Attenuation	\$2,030,000	\$390,000	\$1,230,000	\$3,260,000
Alternative 5 - Perimeter control via air sparging	\$790,000	\$82,000	\$1,570,000	\$2,360,000
Alternative 6 - Air Sparging throughout the plume.	\$4,260,000	\$900,000	\$2,580,000	\$6,900,000

In terms of cost-effectiveness, Alternative 3 represents the best value for the remediation. The higher cost alternatives might achieve the results desired in a shorter time frame. The extra cost is unnecessary since the railroad and the city have no plans for use of this water.

8. State acceptance

The state has expressed support for Alternative 3. The State does not believe that Alternative 1 provides adequate protection of human health and the environment. The State does not support Alternative 2 because it does not involve source control which is needed to prevent a continuing source of contaminants to the plume. Alternatives 4, 5, and 6 have uncertainties and might cause mobilization of the contaminants into the atmosphere and stop natural attenuation by the anaerobic dechlorination reaction.

9. Community acceptance

In general, the community had no negative comments about the preferred alternative (Alternative 3) suggested by EPA. The community expressed no interest in using the ground water.

Principal Threat Waste

The Principal Threat Wastes are chlorinated solvents, mainly TCE, that were used at the former Southern Pacific Railroad Machine Shop and the Union Pacific Railroad Roundhouse to degrease locomotive and engine parts during maintenance and repairs. At the former Southern Pacific Machine Shop, there were two suspected locations for the principal threat wastes: (1) at sumps near the location at the shop where the solvents were routinely used; and (2) in and near an industrial sewer which conveyed the wastes from the sumps at this and other facilities to the former Southern Pacific Wastewater Treatment Facility. Although a recent sampling effort at the Southern Pacific Machine Shop sumps detected TCE in borehole samples, the concentrations were not high enough to suggest a DNAPL layer in that location. An investigation of the industrial sewer indicated that the sewer was filled with sediments and sludges. Furthermore, the investigation revealed that the integrity of the sewer might be suspect, leading to releases into the vadose zone at the site. In addition, it was suspected that the bed of gravel underneath the sewer could provide a preferential flow pathway for the wastes. This finding, along with the shape of the plume (long and narrow along the axis of the sewer) is highly suggestive that the industrial sewer is the major source of the solvents, and therefore the principal threat wastes.

Alternative 1, the no action alternative, does not address the principal threat wastes. Alternative 2, the Monitored Natural Attenuation alternative, also does not address the principal threat wastes. Alternatives 3 - 6 address the major area of principal threat wastes by, at a minimum, inspecting and removal of the industrial sewer which is thought to be the primary source feeding the Northern chlorinated solvent ground water plume. In addition, Alternatives 4 and 6 address the minor pockets of principal threat wastes by injecting air in the areas where the wastes might be present. Since it is unknown that these minor pockets even exist and where, the added benefit of this is uncertain.

Selected Remedy

EPA and UDEQ select Alternative 3, Focused Source Removal and Monitored Natural Attenuation, as the remedial alternative to be implemented at the Ogden Rail Yard Site, OU 4. The remainder of the site requires no further action regarding soils contamination. The soil contaminants are at a level which pose little risk for the site to be used for industrial purposes, its current use.

Summary of the Rationale for the Selected Remedy

Because the contaminated ground water plume is stable and there is ample evidence that a microbial degradation of the chlorinated solvents and intermediate degradation products is occurring, EPA and UDEQ concluded to allow this

process to continue. The modeling also demonstrated that the time the process would take to clean up the contaminated plume was a function of the amount of source material present. Therefore, EPA and UDEQ determined that it was prudent to remove as much of the source material as could be located.

There are two source areas for the chlorinated solvent plumes in the ground water. At the northern plume, because a layer of DNAPL could not be found near the location of solvent use at the northern plume, and because the shape of the plume is long and narrow along the axis of the industrial sewer, the scientific investigators have concluded that the industrial sewer, over 50 years old, is the major source providing a continual release of solvents to the vadose zone over the aquifer. In addition, the investigators have also suspected that the gravel bedding underneath the sewer may also be providing a preferential flow pathway for the contaminants. The source area for the southern plume was not found and has been assumed to have dissipated. The southern plume is the smaller of the two plumes.

The time for cleanup to occur is typically an important consideration in remedy decisions. At this site, the time for cleanup is less of a factor because the ground water is not in use currently for any purpose, and there are no plans for use of these waters in the future. Although some of the Alternatives promise a cleanup in a shorter time frame (with an much higher cost), in this case, the acceleration of cleanup times is not cost-effective, and there are few (if any) benefits to the public by this approach.

One of the main considerations for the selection of Alternative 3 for use in this situation is the fact that the more active remediation techniques proposed (air sparging in Alternatives 4 - 6), involve injection of air into the aquifer. Because the microbial dechlorination reaction which has stabilized the plumes for years is an anaerobic reaction (which occurs in the absence of oxygen), the addition of the oxygen into this plume could stop the microbial actions and could cause the plume to start moving toward the 21st Street Pond. Destabilization of the plume could have unwanted effects. Because the flow rates of the water are quite high, the plume could move past the treatment areas before remediation is complete. EPA and UDEQ felt it was most important to preserve the conditions which have led to stability of the plume, rather than destabilizing the system with the possible negative consequences.

Another practical factor in the choice of Alternative 3 involves the fact that this site is in the midst of an operating rail yard with numerous tracks that are used daily for switching cars, marshalling trains, loading and off-loading of rail cars. Some places where the plume exists are inaccessible without interfering with the normal operations of the yard. Not only would this factor present

operational difficulties for the railroad, it would be difficult for the remediation personnel and could be a severe safety problem.

Finally, EPA and UDEQ endorse the concept that there be a plan in place to deal with the plume should it start to move. Although this is unlikely to occur, changes in hydrology could occur which upset the stability of the plume. The monitoring network should be designed to detect any changes in the plume shape or concentration in sufficient time to protect the rivers and the 21st Street Pond. The selected remedy includes this approach as a contingency even though the likelihood of this occurring is remote.

Description of the Selected Remedy

The selected remedy, Monitored Natural Attenuation with Focused Source Removal, contains the following components:

- On a semi-annual basis, samples will be collected from 20 north and south plume monitoring wells and analyzed for VOCs. Water level gauging would be performed at 50 wells to determine direction and gradient of ground water flow. (See Table 6.1 in Feasibility Study for the initial list.)
- On a yearly basis, a sample would be taken from the 21st Street Pond along the discharge (south) side of the pond to confirm that vinyl chloride levels in the pond do not present a risk. (Can be combined with monitoring required in OU1 Record of Decision)
- Every other year, samples would be collected from 9 north plume monitoring wells and analyzed for geochemical and natural attenuation parameters. Analytes include dissolved oxygen, nitrate/nitrite, ferrous iron, manganese, sulfate, methane, ethane, and ethene. (See Table 6.1 in Feasibility Study for the initial list of wells.)
- Data would be analyzed for concentration vs. time and concentration vs. distance on an annual basis. The data and the analysis would be presented to EPA in an annual report.
- Institutional controls will be implemented by the property owner to restrict access to the ground water via deed restrictions or other mechanism until remediation achieves drinking water standards.
- Once every five years, a summary report of data collected over the previous 5 years would be submitted to EPA. This report would also include an evaluation of an institutional control plan for the site, and an

assessment of the integrity/status of the monitoring wells. (The institutional control plan must prevent access to the ground water.)

- If for some unforeseen reasons, plume concentrations were to increase near the 21st Street Pond, an investigation would be initiated to determine if there were new sources, or if the plume has become destabilized. A corrective action plan would be developed and implemented to protect the pond should there be a new release at the rail yard or if the plumes on the rail yard have started to move again for any reason.
- Removal of the main trunk line of the industrial sewer system, testing of sludges inside and disposal of the sludges in an appropriate facility (see Figure 5).
- Removal of any contaminated soils underneath the main trunk line of the industrial sewer as indicated by presence of vapors or staining.
- Flushing of any remaining sludges from the branch lines of the industrial sewer system, recovery of the sludges, disposal in an appropriate off-site facility, and capping of the branch lines.
- No additional soils removals at the site, other than soils associated with the source control activities, are required. Soil concentrations are within levels appropriate for industrial land use. Should the land use change, this determination must be re-examined and soil removals considered in order to be consistent with the land use proposed.

Summary of the Estimated Remedy Costs

The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of a memorandum in the Administrative Record file, an ESD (Explanation of Significant Differences), or a ROD Amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the action project cost.

KINSER, S. ET AL. 1997. *NOTES ON AN ENGINEERING FORUM ROUNDTABLE DISCUSSION ON PERMEABLE REACTIVE WALLS, U.S. EPA TECHNICAL SUPPORT PROJECT MEETING. ST. PETERSBURG, FLORIDA. FEBRUARY 12.*

NEW JERSEY CORPORATION FOR ADVANCED TECHNOLOGY (NJCAT). 2002. *TECHNOLOGY VERIFICATION STORMWATER MANAGEMENT, INC. JUNE.*

NORTH AMERICAN TREATY ORGANIZATION, COMMITTEE ON THE CHALLENGES OF MODERN SOCIETY (NATO/CCMS). 2003. *PILOT STUDY, EVALUATION OF DEMONSTRATED AND EMERGING TECHNOLOGIES FOR THE TREATMENT AND CLEAN UP OF CONTAMINATED LAND AND GROUNDWATER (PHASE III), 2002 ANNUAL REPORT. NUMBER 255. JANUARY.*

THE FORRESTER GROUP (TFG). 2003. *OGDEN FEASIBILITY STUDY. UNION PACIFIC RAILROAD. OGDEN, UTAH. DECEMBER 30.*

Swingle, R.F. et al. 2001. Data Report: Tank 19F NE Riser Zeolite Mound Sample Analysis. U.S. Department of Energy. WSRC-RP-2001-00410. (Available through <http://sti.srs.gov>)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA). 1988. *GUIDANCE FOR CONDUCTING REMEDIAL INVESTIGATIONS AND FEASIBILITY STUDIES UNDER CERCLA. OFFICE OF EMERGENCY AND REMEDIAL RESPONSE, WASHINGTON, D.C. EPA/540/G-89/004. OCTOBER.*

EPA. 1993. *TECHNICAL RESOURCE DOCUMENT, SOLIDIFICATION/STABILIZATION AND IT'S APPLICATION TO WASTE MATERIALS. OFFICE OF RESEARCH AND DEVELOPMENT, WASHINGTON, D.C. EPA/530/R-93/012. JUNE.*

EPA. 1999A. *SOLIDIFICATION/STABILIZATION RESOURCE GUIDE. OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, WASHINGTON, D.C. EPA/530/B-99/002. APRIL.*

EPA. 1999B. *FIELD APPLICATIONS OF IN SITU REMEDIATION TECHNOLOGIES: PERMEABLE REACTIVE BARRIERS. OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, WASHINGTON, D.C. EPA/542/R-99/002. APRIL.*

VAN BENSCHOTEN, J. ET AL. 2001. *APPLICATION OF A COMPETITIVE CATION EXCHANGE MODEL FOR SIMULATING REMOVAL OF STRONTIUM IN A ZEOLITE PERMEABLE REACTIVE BARRIER. DEPARTMENT OF CIVIL, STRUCTURAL AND ENVIRONMENTAL ENGINEERING, UNIVERSITY AT BUFFALO, BUFFALO, NEW YORK. VIRTA, ROBERT L. ZEOLITES.*

VIRTA, ROBERT. 1995. *ZEOLITES. (AVAILABLE THROUGH [HTTP://MINERALS.USGS.GOV](http://minerals.usgs.gov)).*

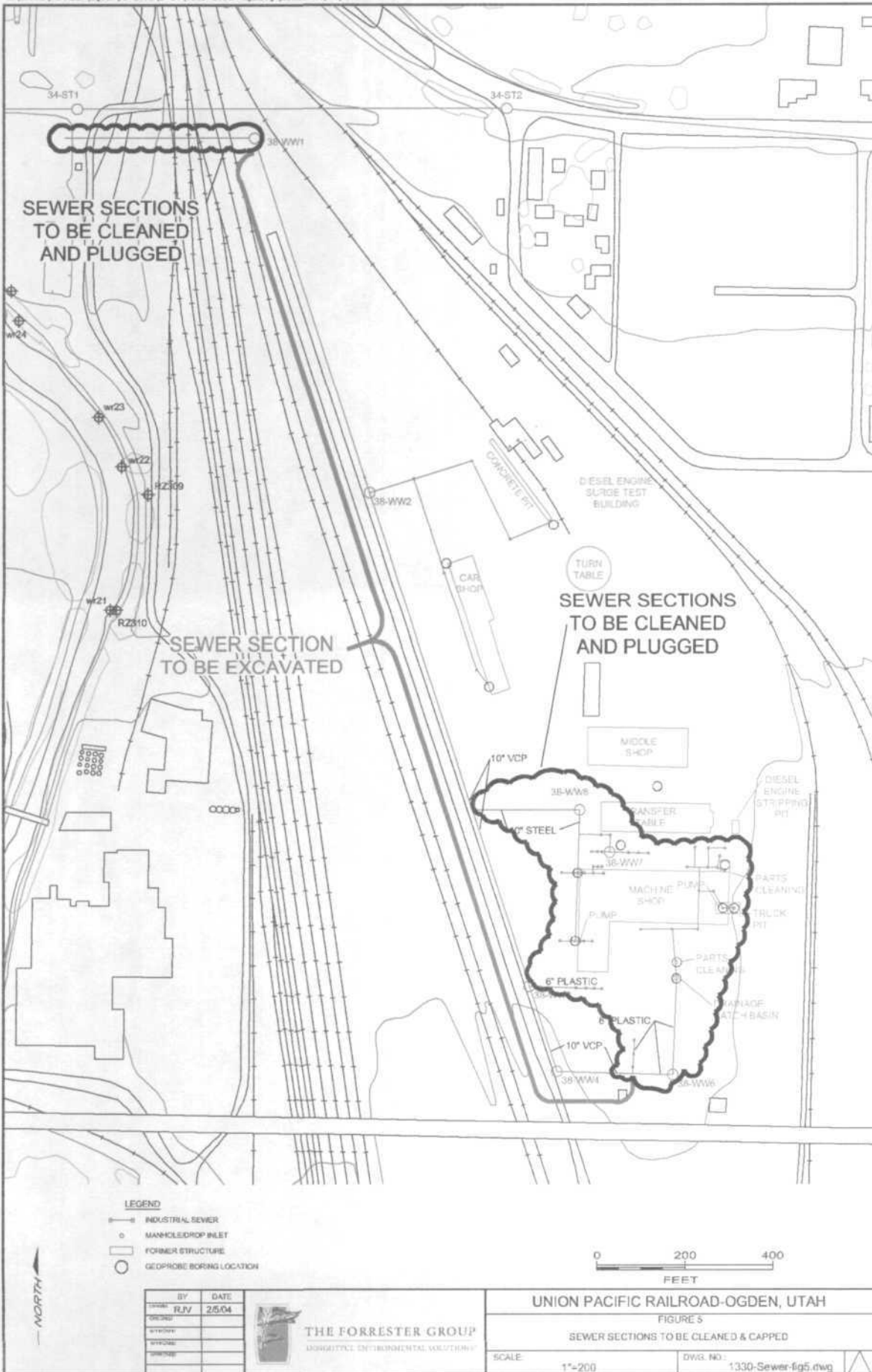


TABLE 22
ESTIMATED COSTS OF THE SELECTED REMEDY

ITEM	BASIS	Quantity	Unit Price	Estimated Amount
CAPITAL COSTS				
A. Sewer Sludge Cleaning and Disposal (branch lines)				
video survey	after cleaning	1	5,600.	5,600
Clean and flush 6" PVC and steel lines	per length of piping	2310 feet	7.95 per foot	18,365
Clean and flush 10" VCP lines	per length of piping	2450 feet	6.89 per foot	16,881
Sludge analysis	TCLP 1 sample/10 CY	3	130.00/ sample	390
Sludge disposal	assumes sludge is hazardous	30 CY or 39 ton	1000/ ton	39,000
Plugging and sealing	for lines remaining in place	1	8,500.	8,500
B. Excavation and Removal of VCP Pipe				
Excavation down to and below pipe	trench 2450 feet long by 2 feet wide by 6 feet deep	2178 CY	6.00/CY	13,067
Soil stockpile	segregate clean overburden from "dirty" materials	2178 CY	1.20/CY	2,613
Confirmation sampling	assumes 1 sample/200 CY	20	100.00	2,000
Disposal and transportation costs	bottom 4 feet in non-hazardous landfill	1,887 ton	31.00/ ton	58,510
Import clean fill	place and compact	1452 CY	15.00/ CY	21,778
Subtotal				186,702
Unscoped items	allow 10%	10%		18,700
Subtotal				205,402
General Requirements	allow 10%	10%		20,500

ITEM	BASIS	Quantity	Unit Price	Estimated Amount
Contract Cost subtotal				225,902
Contingency	allow 30%	30%		67,800
Construction Cost subtotal				293,702
Design	allow 10%	10%		29,400
Construction oversight	allow 10%	10%		29,400
Total				352,502
Total	rounded to nearest 10,000			350,000
OPERATIONS AND MAINTENANCE				
Annual Monitoring Years 1 - 5				
Work Planning	Workplans, logistics, mobilization	1	6,900.	6,900
Semiannual Field Sampling	2 events, 4 days per event, 2 field staff	1	17,400	17,400
Laboratory Analysis	20 wells VOCs per event, 10 wells geochemical every 2 yrs, QC samples	1	10,600	10,600
Annual Reporting		1	10,200	10,200
Subtotal				45,100
Unscoped items	allow 10%	10%		4,500
Contract cost subtotal				49,600
Contingency	allow 15%			7,400
Total Annual Costs				57,000
Net Present Value	discount rate is 7%			233,711
Annual Monitoring Years 6 - 30				
Work planning	workplan, health and safety plan, mobilization	1	3,500.	3,500

ITEM	BASIS	Quantity	Unit Price	Estimated Amount
Annual Field Sampling	1 event, 4 days/event, 2 field staff	1	8,700.	8,700
Laboratory Analysis	20 wells VOCs per event, 10 wells geochemical every 2 yrs, QC samples	1	5,300.	5,300
Annual reporting	half of first 5 years cost	1	5,100.	5,100
Subtotal				22,600
Unscoped items	allow 10%	10%		2,300
Contract cost subtotal				24,900
Contingency	allow 15%	15%		3,700
Total Annual Costs				28,600
Net Present Value	discount rate is 7%			237,633
Five Year Periodic Costs				
Five Year Review Report	Assumes 2.5 times cost of annual report	1	25,500	25,500
Subtotal				25,500
Unscoped items	allow 10%	10%		2,600
Contract Cost subtotal				28,100
Contingency	allow 15%	15%		4,200
Total Costs	every 5 years			32,300
Net Present Value				69,697
Ten Year Periodic Costs				
Monitoring well drilling	assume 2 wells per 10 yrs	2	3,000.	6,000
Oversight and reporting	installation oversight, well logs	1		2,300
Subtotal				8,300
Unscoped items	allow 10%	10%		800

ITEM	BASIS	Quantity	Unit Price	Estimated Amount
Contract cost (subtotal)				9,100
Contingency	allow 15%	15%		1,400
Total	every 10 years			10,500
Net Present Value				9,430
SUB-TOTAL NET PRESENT VALUE				550,472
SUB-TOTAL NET PRESENT VALUE (rounded)				550,000
TOTAL (Net Present Value)				\$900,000

Expected outcomes of the selected remedy

The expected outcome for this remedy is that the plume of chlorinated hydrocarbons would begin to decrease over time both in size and concentrations. Modeling exercises revealed that the time of remediation depends heavily on the amount of source and the groundwater velocity. For the sake of comparison, with an original source of 4000 pounds which is arrayed in a linear configuration and no source removal, the time to achieve 4 ug/l of 1,1,1-TCA in the ground water would be about 90 years. If, on the other hand, 90% of the source is removed when the industrial sewer is excavated and removed, the time to achieve this same goal would be about 32 years.

The land can continue in its present use as a rail yard (or other industrial use).

The water will not be useable for drinking or indoor uses while the natural attenuation process is ongoing, but the water is not used for this presently. The railroad can prevent others, even those with water rights, from developing the ground water. Although the source removal will reduce the time it takes to restore the aquifer, it will still take a long time (10s of years, depending on the percentage of the total source removed). Institutional controls will prevent the water from being used for domestic purposes until drinking water standards are achieved. In the interim, the ground water will continue to have beneficial uses as a recharge to the 21st Street Pond, a wildlife habitat area.

The contaminated groundwater plume of the northern plume has not reached the groundwater sink in the area, the 21st Street Pond. Therefore the groundwater plumes do not pose a current risk to the wildlife in, on and near the pond. When the source removal is complete and the groundwater plume begins to shrink, the risks to uses of the pond as a wildlife habitat and for recreation will be reduced. Contingency plans will be available if the ground water should begin to encroach upon the pond for any reason.

Final cleanup levels

The ultimate objective for the groundwater remedial action is to restore contaminated ground water at the Northern and Southern CVOC plumes to the extent that they no longer pose a threat to the nearby receiving water bodies, the 21st Street Pond and the Weber River. This water is not currently used for drinking water purposes, nor are there any plans to use these ground water resources for a drinking water supply in the future. EPA and UDEQ believe that the Selected Remedy can achieve a level of contaminants which are safe at the time the ground water discharges into the river and pond, the immediate goal. Achieving drinking water standards is a long-term goal.

Monitored natural attenuation (Alternative 3) will be used to restore the contaminated ground water at the Northern and Southern CVOC plumes to their current beneficial use as a recharge to the 21st Street Pond. Cleanup levels for each chemical of concern is specified in Table 23.

TABLE 23
CLEAN UP CONCENTRATION LEVELS AND POINTS OF COMPLIANCE

CONTAMINANT OF CONCERN	CLEAN UP LEVEL	CLEAN UP LEVEL	CLEAN UP LEVEL
Basis of level	Surface Water Quality Standard for 21 st Street Pond	Surface Water Quality Standard for 21 st Street Pond	Drinking water MCLs
Point of compliance	At wells between the current plume and the 21 st Street Pond	Throughout the plume	Throughout the plume
Consequence of non-attainment	Contingency plans must be implemented to protect the pond	Monitoring must continue	Institutional controls must continue
Consequence of attainment	No additional protective measures	Routine monitoring can cease, occasional checks only	Institutional controls may be released
1,2-dichloroethylene	3.2	3.2	7
vinyl chloride	530	530	2

Current estimates indicate that cleanup levels throughout the plume will be achieved in 32 years (assumes a 90% source removal, Appendix C, Feasibility Study). This compares to an estimated minimum time frame of 5-10 years for those alternatives that involve air sparging of the plume (Alternatives 4, 5, and 6). Although the estimated time for natural processes to attain remediation objectives is longer than that required for alternatives using air sparging, 32 years is considered a reasonable remedial time for this site because there is no anticipated need for the contaminated ground water within this period. It remains a potential resource for the future.

In addition to the modeling estimates, the concentration levels for all COCs have remained stable over the past several years and are likely to begin decreasing once the major source area has been removed.

Actual performance of the natural attenuation portion of the remedy will be carefully monitored in accordance with the monitoring plan as detailed in Table 6.1 of the Feasibility Study (which includes a list of wells and analytes required). If monitoring data indicate that contaminant levels do not decline or that the plume is encroaching upon the receiving water, a contingency corrective action plan will be developed and implemented.

Institutional controls will be implemented to prevent the use of contaminated ground water for drinking, domestic or other indoor uses. This is possible because the railroad owns all of the land above the contaminated ground water and can prevent access to anyone wishing to develop the ground water, with or without water rights.

Statutory Determinations

Under CERCLA §121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and bias against off-site disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements.

Protection of Human Health and the Environment

The Selected Remedy, Alternative 3, will protect human health and the environment through monitored natural attenuation which has already been demonstrated to have stabilized the plume movement toward the receiving waters. The current potential risk of ingesting groundwater at the site is about 3×10^{-3} . Use of institutional controls will prevent potential access to the plume while the natural processes are on-going, thereby totally eliminating any exposure to humans from this source. Monitoring will give adequate warning should the contaminated plume progress toward the receiving waters where it would pose a risk to wildlife. The remedy includes contingency plans should the plume unexpectedly begin to move toward the receiving waters.

Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy of monitored natural attenuation and focused source control complies with all ARARs. The ARARs are presented below.

Chemical, Location, and Action-Specific ARARs include the following:

- Safe Drinking Water Act MCLs (40 CFR Part 141, and R309-200-5 UAC) which specify acceptable concentration levels in ground water that serve as a potential drinking water source. The institutional controls portion of the remedy will remain in place so long as concentrations of contaminants in the ground water exceed the drinking water standards.

- Clean Water Act (40 CFR Part 131, and R317-2-UAC) which specify water quality criteria for protection of aquatic life in state and federal surface waters. The monitoring program will determine if the contaminants begin to move toward receiving waters. The contingency remedy will protect the receiving water should the contaminants begin to move unexpectedly. The monitoring portion of the remedy will remain in place so long as the concentrations of contaminants in the ground water exceed the water quality standards.
- RCRA (40 CFS Part 262 and R315-5 UAC) which specifies chemical characteristics of a hazardous waste. The wastes recovered during the source control sewer flushing and excavations will be tested so that they can be sent to an appropriate off-site Subtitle C or D TSD (treatment, storage, disposal) facility.
- RCRA (40 CFR 264.554) which has requirements for staging piles of remediation wastes prior to transportation and disposal. If wastes from the excavation of the industrial sewer are staged prior to transportation for treatment and disposal at an off-site facility, these regulations will be followed.
- Well drilling standards (R655-4 UAC) which establishes standards for drilling and abandonment of wells, will be met during the course of well drilling and abandonment at the site.
- Note that other ARARs would be relevant to the site should implementation of a contingency remedy be necessary. Those would depend on the action needed.

Cost Effectiveness

In the lead agency's judgment, the Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this alternative represents a reasonable value for the money to be spent.

The estimated present worth cost of the Selected Remedy is \$900,000. In terms of cost-effectiveness, Alternative 3 represents the best value for the remediation. The higher cost alternatives might achieve the results desired in a shorter time frame, but the extra cost is unnecessary since there are no plans for use of this water by either the railroad or the community.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable.

Using the monitored natural attenuation remedy which works by microbial reductive dechlorination for the chlorinated solvents has the potential to be both effective and permanent given a reasonable time frame. Since microbial processes qualify as an alternative treatment technology, it also qualifies as maximum use of this in-situ remedial process. Removal of the industrial sewer is a permanent solution

The principal threat at the site, sludges within and outside the industrial sewer at the site, will not be treated at the site, but taken off-site for any necessary treatment prior to disposal at an appropriate TSD facility.

Preference for Treatment as a Principal Element

Treatment is used as a significant element of the remedy, namely monitored natural attenuation (in situ microbial reductive dechlorination). Off-site treatment and disposal is used for the source control element of the remedy. Since the major element of the remedy, natural attenuation, is a treatment remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied. More active forms of treatment could disrupt the natural process and destabilize the plume. This approach would be counterproductive.

Five Year Review Requirements

Because this remedy will result in hazardous substances or pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a policy review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. Although this site has not been proposed or listed for the National Priorities List, the regional policy review is needed to maintain parallelism between this Superfund Alternative Site with the NPL sites in the region.

Documentation of Significant Changes

The Proposed Plan for the Ogden Rail Yard OU 4 Site was released for public comment in May, 2004. The Proposed Plan identified Alternative 3, monitored natural attenuation with focused source removal, as the Preferred Alternative for ground water. EPA reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

PART 3: RESPONSIVENESS SUMMARY

Stakeholder Comments and Lead Agency Responses

Public Hearing, May 26, Weber Center Commission Chambers, Ogden

Commenter: Gary Lappin, Mineral Tech

Comment: There is an experiment going on in Coeur d'Alene Lake, and we treated a pond in that study. The water there is contaminated with mercury, lead, and arsenic.

Response: EPA and UDEQ have tasked an independent remediation firm to investigate the possible utility of zeolite at the site. The contaminants of interest are chlorinated solvents and their degradation products, not metals. See appendix A.

Commenter: Unknown.

Comment: In response to EPA question - does anyone know of any other problems in the rail yard that the agencies overlooked in their studies? No, I think you hit everything.

Response: We believe the RI/FS did study the issues sitewide. All the problems found were either addressed using other authorities, such as the Underground Storage Tanks Program and Removal Authorities. The remainder of the problems will be addressed as a part of this Record of Decision or the Record of Decision involving the 21st Street Pond.

Technical and Legal Issues

No unresolved legal or technical issues have been identified.

**POTENTIAL USE OF ZEOLITES AS A REMEDIAL TECHNOLOGY
PROPOSED PLAN FOR OPERABLE UNITS NUMBERS 1 AND 4
OGDEN RAIL YARD SITE
OGDEN, UTAH**

The U.S. Environmental Protection Agency (EPA) completed the proposed plan for Operable Units (OU) Nos. 1 and 4 at the Ogden Rail Yard located in Ogden, Utah. The proposed plan informs and solicits the views of the public on the preferred cleanup alternative for these operable units. In a public hearing on the proposed plan, EPA received a comment from Mr. Brent Waters of Mineral Technology Inc. (Min-Tech) (a mining company in eastern Oregon) inquiring about the potential use of zeolites as a remedial technology for the site. In accordance with the National Contingency Plan (NCP), EPA is required to respond to each comment received during the public comment period. As a result, this document was prepared to evaluate the potential use of zeolites as a remedial technology for OUs 1 and 4 at the Ogden Rail Yard site.

Project Background and Remedial Alternatives

The Ogden Rail Yard has been in operation since 1869. Four major railroad companies used the rail yard for switching, maintenance of locomotives and railcars, and for loading, off-loading, icing, and transferring cargo. The rail yard is 3.5 miles long (oriented from north to south) and about ½ mile wide. The boundaries of the site are the 21st Street Pond on the north, the Weber River on the west, the Riverdale Road overpass on the south, and Wall Street on the east.

In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §117(a) and the NCP at Title 40 Code of Federal Regulations (CFR) Part 300.43(f)(2), EPA has published the proposed plan for the following operable units:

OU 1 – Northern Area, 21st Street Pond and associated source

OU 4 – Groundwater (plumes of chlorinated volatile organic compounds)

The following text discusses these operable units.

Operable Unit No. 1 – 21st Street Pond

The 21st Street Pond, which has been designated as OU 1, is at the northern end of the rail yard. Contaminants associated with this operable unit include petroleum-based residues associated with a former Pintsch Gas Plant. As described in the proposed plan, EPA and the Utah Department of Environmental Quality (UDEQ) have tentatively selected a remedy (Alternative 5) that involves the following remedial processes:

- Pumping and disposing wastes that have accumulated underground in pools
- Excavating contaminated sediments from the 21st Street Pond
- Installing an underground dam to prevent wastes from recontaminating the pond
- Implementing institutional controls, which would prevent access and use of the groundwater and prevent any change in land use at this portion of the site.

However, during the public comment period, community activists pointed out the importance of the pond as a valuable recreational resource and described how they would like the pond to be reopened for that purpose. The City of Ogden, in a resolution of the City Council, expressed a preference for Alternative 3 as a cost-effective alternative that would allow the pond to be reopened for public use. Based on information gathered during the public comment period, EPA and UDEQ have reassessed the feasibility of the remedial alternatives. As described in the record of decision (ROD), EPA and UDEQ have selected Alternative 3 for OU1 (21st Street Pond) of the Ogden Rail Yard site. The remedy consists of capping the contaminated sediments in the pond, recovery of mobile dense nonaqueous phase liquid (DNAPL) from pools on top of a buried clay layer, and institutional controls. As described in the Ogden Rail Yard Feasibility Study (TFG 2003), the following other remedial options were also evaluated for this operable unit: no action; maintenance of interim cleanup measures such as fish gates and controls to prevent use of groundwater and the land; burial of the contaminated sediments in the pond and pumping out any pools of accumulated waste; removal of contaminated sediments and treatment of wastes; and removal of contaminated sediments and mobile wastes.

Operable Unit No. 4 – Groundwater

OU 4 involves two plumes of chlorinated solvents in groundwater, one originating near the former Southern Pacific

machine ship, and the other originating near the former Union Pacific roundhouse. As described in the proposed plan, EPA and UDEQ have tentatively selected a remedy that involves the following options:

- Institutional controls
- Source removal
- Monitored natural attenuation
- Other actions if needed to prevent the groundwater from contaminating the river or the 2nd Street Pond.

As described in the Ogden Rail Yard Feasibility Study (TFG 2003), the following other remedial options were also evaluated for this operable unit: no action; monitored natural attenuation (without source controls); monitored natural attenuation with aggressive treatment near the sources; monitored natural attenuation with treatment at the perimeters of the plume; and treatment throughout the plume.

Potential Use of Zeolites as a Remedial Technology

Available information on the potential use of zeolites as a remedial technology at the site (for example, its adsorption properties, other physical and chemical properties, case studies, and unit costs) was gathered using standard Internet search techniques, including a search using Dialog. Dialog is a collection of more than 900 databases that contain more than 500,000 sources that provide global coverage of scientific, technical, medical, business, news, and intellectual property information. Product information on zeolites from Min-Tech was also solicited and received as part of this literature search. Information provided by Min-Tech included the following publications:

- Bouffard, Sylvie and Duff, Sheldon 2000
- Bowman, Robert and others. 1999d.
- Currier, Brian and others. 2001.
- Davis, Johnston and Davis, G. B. 1997.
- Guney, Yucel and Koyuncu, Dr. Hakan. 2003.
- NEW JERSEY CORPORATION FOR ADVANCED TECHNOLOGY (NJCAT) TECHNOLOGY VERIFICATION STORMWATER MANAGEMENT, INC. 2002.
- Swingle, R.F. and others 2001.
- VIRT, ROBERT L. 1995

Available information on the use of zeolites as a remedial technology is summarized and referenced below. In addition, the results of the Dialog literature search and information provided by Min-Tech are included as Attachments 1 and 2.

Zeolites are three-dimensional, microporous, crystalline minerals with well-defined structures that contain aluminum, silicon, and oxygen in their regular framework; cations and water are located in the voids of the framework. These natural minerals are mined in many parts of the world; however, most zeolites used commercially are produced synthetically. The silicon and aluminum atoms form tetrahedral structures with shared oxygen atoms.

Void spaces in the zeolites can host cations, water, or other molecules. The three major applications of zeolites are:

Adsorption: Zeolites are used to adsorb a variety of materials. They can remove water to low partial pressures and are effective desiccants, with a capacity of up to more than 25 percent of their weight in water. In 1995, pet litter and animal feed were the two largest markets for natural zeolites (Virta 1995). They are commonly used to remove volatile organic compounds (VOCs) from airstreams and to separate isomers and mixtures of gases. In addition, zeolites are used to remove metals from water. Zeolites are not commonly used to remove VOCs from water.

Catalysis: The main industrial applications for zeolites are as catalysts for petroleum refining, synfuels production, and petrochemical production.

Ion Exchange: The largest-volume use for zeolites is in detergent formulations where zeolites have replaced phosphates as water-softening agents. This replacement is accomplished by exchanging the sodium in the zeolite for the calcium and magnesium in the water.

Several potential remedial technologies were considered using zeolites based on these primary properties of zeolites, the contaminants of concern, and the contaminated media at each operable unit. This approach for technology identification is consistent with the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988) and the Ogden Rail Yard Feasibility Study (TFG 2003, Appendix E). The technology identification for zeolites is presented below:

POTENTIALLY AFFECTED MEDIA AND TECHNOLOGIES		
MEDIUM	GENERAL RESPONSE ACTION	CANDIDATE ZEOLITE TECHNOLOGY
OPERABLE UNIT NO. 1 – 21ST STREET POND; CONTAMINANTS OF CONCERN: HYDROCARBONS INCLUDING COAL TAR AND DIESEL FUEL-RELATED CONSTITUENTS		
SEDIMENTS (21ST ST. POND)	CONTAINMENT	ADSORPTIVE LAYER
	SOIL TREATMENT	STABILIZATION
GROUNDWATER	EX SITU TREATMENT	ION EXCHANGE/ADSORPTION
	IN SITU PHYSICAL-CHEMICAL TREATMENT	PASSIVE TREATMENT BARRIER
DNAPL	IN SITU PHYSICAL-CHEMICAL TREATMENT	PASSIVE TREATMENT BARRIER
LNAPL	IN SITU PHYSICAL-CHEMICAL TREATMENT	PASSIVE TREATMENT BARRIER
OPERABLE UNIT NO. 4 – GROUNDWATER; CONTAMINANTS OF CONCERN: CHLORINATED SOLVENTS AND DEGRADATION COMPOUNDS		
GROUNDWATER	EX SITU TREATMENT	ION EXCHANGE/ADSORPTION
	IN SITU PHYSICAL-CHEMICAL TREATMENT	PASSIVE TREATMENT BARRIER

Available information on the feasibility for using zeolites in each of these remedial technologies is discussed below.
Cover or Containment for Contaminated Sediments at OU 1

Information on past applications of zeolites as a cover material was not identified during the literature search. A bench-scale pilot study is currently being conducted by the North Atlantic Treaty Organization, Committee on the Challenges of Modern Society (NATO/CCMS) to investigate the possible use of zeolites and zeolites that contain bentonite compounds as a surface barrier to prevent migration of pollution (NATO/CCMS, 2003). This study is still in process, so the full conclusion is not currently available.

Caps or covers are generally constructed to prevent direct exposure to contaminated soils and sediments and infiltration of precipitation into the segregated waste material (in other words, to prevent leaching of contaminants to groundwater). To achieve these objectives, covers are generally constructed of multiple layers of different materials, including native soils, bentonite or other clay materials, and synthetic membranes. Cover materials are not typically selected based on their adsorptive properties, however. Rather, the cover system is designed to function as a stable, long-term barrier to prevent direct exposure to the segregated waste. The unique physical and chemical properties of zeolites (adsorption, catalysis, and ion exchange) are not focused on this objective. Moreover, because of the innate adsorptive properties of zeolites, it allows for transfer of fluid through the entire compound and is therefore not an effective cover material to prevent infiltration of surface water.

In Situ Stabilization of Contaminated Sediments at OU 1

The term "solidification/stabilization" refers to a general category of processes that are used to treat a wide variety of wastes, including solids and liquids. Solidification and stabilization are each distinct technologies, as described below (EPA 1993, 1999a):

- Stabilization refers to techniques that chemically reduce the hazard potential posed by a waste by converting the contaminants into forms that are less soluble, mobile, or toxic. The physical nature and handling characteristics of the waste are not necessarily changed by stabilization.
- Solidification refers to techniques that encapsulate the waste, forming a solid material, and does not necessarily involve a chemical interaction between the contaminants and the solidifying additives. The product of solidification, often known as the waste form, may be a monolithic block, a clay-like material, a granular particulate, or some other physical form commonly considered "solid."

Stabilization/solidification is typically used to address inorganic (metals) contaminants in soil and sediment. Information on past applications of zeolites as absorbent or stabilization materials for in situ treatment of soil and sediment contaminated by petroleum or chlorinated solvents was not identified during the literature search. It is unclear whether the use of zeolites could function as a cost-effective, long-term stabilization technique without the contaminant repartitioning (leaching). Although this remedial technology has been used in the past to address organic contamination, treatment technologies that destroy degradable contaminants such as petroleum hydrocarbons and chlorinated solvents are preferred (EPA 1993).

Ex Situ Groundwater Treatment at OU 1 and OU 4

The conventional approach for remediating contaminated groundwater has been to extract the contaminated water, treat it above ground, and reinject or discharge the clean water in a process known as "pump-and-treat." The contaminants recovered must be disposed of separately. Pump-and-treat technologies require considerable investment over an extended period, and it has been shown that these technologies often do not remove the source of the contamination. Current policies and laws stress "permanent" remedies over simple containment methods. Consequently, there is considerable interest in and effort being expended on alternative, innovative treatment technologies for contaminated groundwater. Accordingly, groundwater extraction and ex situ treatment (pump-and-treat) was not selected as the preferred remedy at Ogden Rail Yard OU 1 and OU 4. Nevertheless, information on past applications of zeolites as an ex situ treatment for groundwater contaminated by petroleum or chlorinated solvents was not identified during the literature search. Therefore, even if ex situ treatment was further considered, the use of zeolites as a contaminant absorbent would not likely be the preferred treatment option. Its selection probably would be precluded by the common and cost-effective use of granular activated carbon (GAC) and other techniques to treat petroleum hydrocarbon and chlorinated solvent contaminants in groundwater.

Use of Zeolites as Permeable Reactive Wall Material at OU 1 and OU 4

A PRB is a passive in situ treatment zone of reactive material that degrades or immobilizes contaminants as groundwater flows through it. PRBs are installed as permanent, semi-permanent, or replaceable units across the flow path of a contaminant plume. Natural hydraulic gradients transport contaminants through strategically placed treatment media. The media degrade, sorb, precipitate, or remove chlorinated solvents, metals, radionuclides, and other pollutants. These barriers may contain reactants for degrading volatile organics, chelators for immobilizing metals, nutrients and oxygen to enhance bioremediation, or other agents (EPA 1999b).

The choice of reactive medium for PRBs is based on the specific organic or inorganic contaminant to be remediated. Most PRBs installed to date use zero-valent iron (Fe^0) as the reactive medium for converting contaminants to non-toxic or immobile species. For example, Fe^0 can reductively dehalogenate hydrocarbons, such as converting trichloroethylene (TCE) to ethylene, and reductively precipitate anions and oxyanions, such as converting soluble Cr^{+6} oxides to insoluble Cr^3 hydroxides. The reactions that take place in the barriers depend on parameters such as pH, oxidation/reduction potential, concentrations, and kinetics. The hydrogeologic setting at the site is also critical: geologic materials must be relatively conductive, and a relatively shallow aquitard must be present to contain the system.

Several studies were identified during the literature search on the potential application of zeolites in a PRB to address petroleum hydrocarbons or chlorinated solvents in groundwater. The NATO/CCMS pilot study mentioned previously is also investigating the large-scale, in situ application of degrading chlorinated hydrocarbons using palladium coated Y-zeolites (NATO/CCMS 2003). One important aspect of this in situ pilot study is the pilot facility. This pilot facility, officially opened in 1999, guarantees that the treatment technologies selected will be tested under realistic conditions. This study is still in process, so the full conclusion is not currently available. A limited conclusion, however, showed that zeolites exhibited a high capability for efficiently degrading aliphatic as well as aromatic chlorinated hydrocarbons. However, Pd-catalysts are deactivated by the production of hydrogen sulfide (H_2S) through the microbiological reduction of sulfate (SO_4). Attempts to suppress microbial activities to increase the longevity by applying periodical pulses of peroxide (H_2O_2) so far showed only limited success (NATO/CCMS 2003).

Few bench-scale studies have been performed to evaluate the potential use of zeolites as a PRB to remove petroleum hydrocarbons from groundwater. Available literature indicates that zeolites have absorbent and ion-exchange capabilities that may effectively remove strontium (Sr) from groundwater (Van Benschoten and others 2001). In addition, a recent large-scale study showed that a PRB that contained zeolites retained 100 percent of Sr-90 since it was installed (EPA 1999b). Bench-scale studies have indicated that surface-modified zeolites may be able to effectively treat cations, organics, and cyanides (Kinser and others 1997). However, pilot- and field-scale studies

have not yet been performed.

Recent studies have also evaluated the possibility of using low-cost natural zeolites (\$110/ton) treated with cationic surfactants (hexadecyltrimethylammonium [HDTMA] or methyl-4-phenylpyridinium) to remove benzene, toluene, p-xylene, ethylbenzene, tetrachloroethane (TCA), and perchloroethylene (PCE) from aqueous solution (Bowman 1994a, b). This bench-scale study showed that unmodified zeolites had no affinity for the organic compounds. Conversely, surfactant-modified zeolites, which remained stable in aggressive aqueous solution and organic solvents, sorbed these organic compounds via a partitioning mechanism; sorption affinity was in the order of the sorbates' octanol-water partition coefficient. Further pilot-scale studies demonstrated the use of a surfactant-modified zeolite (SMZ) PRB to remediate groundwater contaminated by hexavalent chromium (Cr^{6+}) and PCE in a contained, simulated aquifer at the Oregon Graduate Institute of Science Technology near Portland, Oregon (Bowman and others 1999c). Preliminary results of the pilot test indicate that the barrier is performing according to design specifications, with retardation factors for chromate and PCE both on the order of 50. Based on these experiments, researchers recommend a minimum 100-fold permeability contrast between the PRB and the aquifer material. The causes for poor permeability contrast, whether a result of inherent differences in the property of the media or of barrier installation, can be difficult to isolate. The study concluded that SMZ permeable barriers can be successfully deployed under field-like conditions and can provide hydraulic containment. Furthermore, the physical and chemical properties of the bulk-produced SMZ are essentially identical to SMZ prepared in the laboratory. In particular, the contaminant (chromate and PCE) sorption characteristics of bulk- and laboratory-produced SMZ are the same (Bowman and others 1999d). This study also recommended intensive sampling in evaluating prospective permeable barrier systems. Consequently, performance of the barrier would be difficult to evaluate without an extensive sampling array and close monitoring of contaminant plumes. Long-term compaction of the material with resulting loss in hydraulic conductivity also requires further evaluation (Bowman and others 1999d). Based on information provided by Min-Tech, the unit cost of raw unmodified zeolites is approximately \$85/ton. However, given that unmodified zeolites have no affinity for the organic compounds, the cost of modified zeolites are approximately three to five times the cost of natural zeolites (Bowman and others 1999a,b). Information is not currently available regarding long-term operation and maintenance of PRBs containing zeolites.

Conclusions and Recommendations

Based on the literature search and review of the potential uses of zeolites as a remedial technology, the physical and chemical properties of zeolites, and the constituents of concern and remedial objectives for the Ogden Rail Yard OU 1 and OU 4, the use of zeolites at the facility is not recommended. However, the proposed plan allows for contingencies, particularly at OU 4, in the event that the remedial alternatives selected do not achieve the remedial objectives. If the alternatives are re-evaluated in the future, the use of zeolites as a remedial technology may be considered.

References

- Bouffard, Sylvie and Duff, Sheldon. 2000. *Uptake of Dehydroabiatic Acid Using Organically-Tailored Zeolites*. Proceeding of the 1993 CSCE-ASCE National Conference on Environmental Engineering, July 12-14, Montreal, Quebec, Canada, 1103-1109.
- Bowman, Robert. 1994a. *Sorption of Nonpolar Organic Compounds, Inorganic Cations, and Inorganic Oxyanions by Surfactant-Modified Zeolites*. *Wat. Res.* Vol. 34, No. 9, pp. 2469-2476.
- Bowman, Robert. 1994b. *Organo-Zeolites for Sorption of Nonpolar Organics, Inorganic Cations, and Inorganic Anions*. Proceeding of the 1993 CSCE-ASCE National Conference on Environmental Engineering, July 12-14, Montreal, Quebec, Canada, 1103-1109.
- Bowman, Robert et al. 1999c. *Pilot-Scale Testing of a Surfactant-Modified Zeolite PRB*. *GroundWater Currents*. EPA/542/N-99/002. (Available through <http://clu-in.org>.)
- Bowman, Robert et al. 1999d. *Surface-Altered Zeolites as Permeable Barriers for in-situ Treatment of Contaminated Groundwater*. Phase II Topical Report, Contract #DE-AR21-95MC32108.
- Currier, Brian et al. 2001. *California Department of Transportation BMP Retrofit Pilot Program*. Proceeding of the 2001 Transportation Research Board 8th Annual Meeting, January 7-11, Washington, D.C.
- Davis, Johnston and Davis, G. B. 1997. *An Overview of Current Research on Remediation of Soils and Aquifers Contaminated by Organic Compounds*. Center for Groundwater Studies. Technical Report No 4/97. June.
- Guney, Yucel and Koyuncu, Dr. Hakan. 2003. *Improvement and Distribution of Contaminant Dark Green River Sediment*. Proceeding of the 2003 First International Conference on Environmental Research and Assessment, March 23-27, Bucharest, Romania.